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Complete.

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# THE JOURNAL

OF

# THE LINNEAN SOCIETY.

## ON THE SUBSUBAREAS OF BRITISH INDIA, illustrated by the detailed Distribution of the *Cyperaceæ* in that Empire.

By C. B. CLARKE, M.A., F.R.S., F.L.S.

[Read 2nd June, 1898.]

(With MAP—PLATE 1.)

### INTRODUCTION.

BRITISH INDIA having been treated as a Subarea of the Indo-Chinese Area *, the present paper attempts to divide it into a convenient number (11) of Subsubareas for botanic reference. As a test of the convenience of these subsubareas, and as an illustration of how they are intended to be employed, the whole of the material used in preparing the Order Cyperaceæ for Sir J. D. Hooker's 'Flora of British India' has been tabulated upon this framework. This is a somewhat lengthy process, but it is believed that only by a somewhat full trial can the convenience of a scheme of subsubareas be tested; moreover, it affords an opportunity for the suggestion of improvements in the scheme of subsubareas proposed. The tabulation is also a complete account of the geographic distribution of the Cyperaceæ in British India, and thus forms an Appendix to Sir J. D. Hooker's 'Flora' in which the distribution is only given generally; the present paper is an Index to all the localities and all the collectors' numbers actually used in the Cyperaceæ for the 'Flora of British India.'

---

* Phil. Trans. vol. 183 B (1892), p. 371.

At the end of the paper, as an inference more particularly from the distribution of the genus *Carex*, there is ventured some speculation upon the components of the existing Flora of British India and their successive entry into and route within the Empire.

India has been regarded as a botanic subarea of the globe; the Empire is not the most natural region that could be devised; it is convenient as a subarea of reference, especially now that Sir J. D. Hooker's 'Flora of British India' is completed. The next step, both towards the geographic and economic study of the Flora, is the subdivision of India into convenient subsubareas; for each of these subsubareas a local Flora of manageable size may be written, and the distribution of species in India may be more precisely indicated by "tabulating" on these subsubareas by way of reference. The Floras of Ceylon and of the Malay Peninsula have now been carried so far that the areas included in these Floras must be taken as two of the subsubareas.

I commenced work on this subdivision of India about two years ago; having formed my subsubareas (in which I have had the benefit of the advice of Mr. Hemsley, Sir G. King, Mr. Gamble, Dr. Prain, and others), I proceeded to test them in practice by tabulating on them an Order of considerable size. I think it is only by working the subsubareas with large numbers of plants that any safe conclusions can be come to regarding their convenience. I selected the Order Ranunculaceæ; but, after collecting the literature, I found that, to make the test of any value, it would be necessary to revise critically the whole material. I was quite unable to undertake this (in addition to other botanic work in hand), and threw aside the papers. Some time after, it occurred to me that I might test my subsubareas with the Order Cyperaceæ, by assuming all the determinations I have already made of Indian Cyperaceæ to be correct, and not referring to the plants at all. This I have here done; only citing the localities and numbers of collectors *which I had on my notes already*. This, *inter alia*, causes *Carex* to be very scantily done as compared with the other genera; because in working up *Carex* for the 'Flora of British India' only the material at Kew and at the Linnean Society was employed. But, oing the work in this way, *i. e.* merely copying from my own determinations, the present tabulation has occupied me about

1½ hour (I estimate on the average) of all my working days for eight months.

I mention this as it is the primary consideration in a scheme of subsubareas how the work upon the framework is to come within manageable dimension. I made the number of subsubareas 11; from my experience I strongly opine that this number is quite large enough. I am sure that anyone who tabulates on a larger number will be overwhelmed if he attempts to deal with any considerable part of the Flora of India. The subsubareas can be made more natural by further subdivision; it has been pointed out to me that the mountainous south-west of Ceylon is distinct as a biologic region from the drier north-east. In applying to my friends for suggestions, I have always asked them to show me how to improve my scheme of subsubareas of India, the number of such subsubareas remaining 11 or less.

So far as *areas* of reference are concerned, it is to be noted that it is no use giving them accurately-defined boundaries unless collectors note the habitats of their collections with reference to these. If I make the Tropic of Cancer the limit of a subsubarea and a collector has ticketed a plant "Chota Nagpore," I cannot refer it to any subsubarea. Now the "type" examples of nearly the whole of the Indian Flora have already been collected, so that the scheme of subsubareas has to be largely confined to the problem of devising such subsubareas as will admit the standard material for the Flora of British India being referred to them. A very large percentage of this material is ticketed as having been collected at a very limited number of localities, as "North-west Himalayas," "Pegu," "Moradabad"; it is this fact which has enabled me to carry out the tabulation of the plants at all. Large numbers of Wight's plants are only ticketed "Madras," or "herb. Madras"; and the majority of these carried into Wallich's herbarium have, of course, no better localization; I have tabulated these, as a rule, in subsubarea **5**, Coromandelia, but it is known that many came from Malabaria and Ceylon. So the plants of Griffith, with the printed Kew label "East Bengal" on them, came some from Darjeeling, some from East Bengal Plain, some from Khasia, some from other places. The percentage of doubt and guess thus introduced is so large, that I can lay no great stress on the *numerical* results. I have withdrawn the tables showing the specific distribution and have printed only the abstract tables. The tabulations for the distribution of species can be constructed by anyone who wants them out of this paper. I publish the paper, firstly as recording and defining geographically the whole material on which the Cyperaceæ (in the 'Flora of British India') stand; and secondly, as the ground for some speculations which I have added regarding the derivation of the existing Flora of British India.

The 11 subsubareas of tabulation adopted are (see Map):—

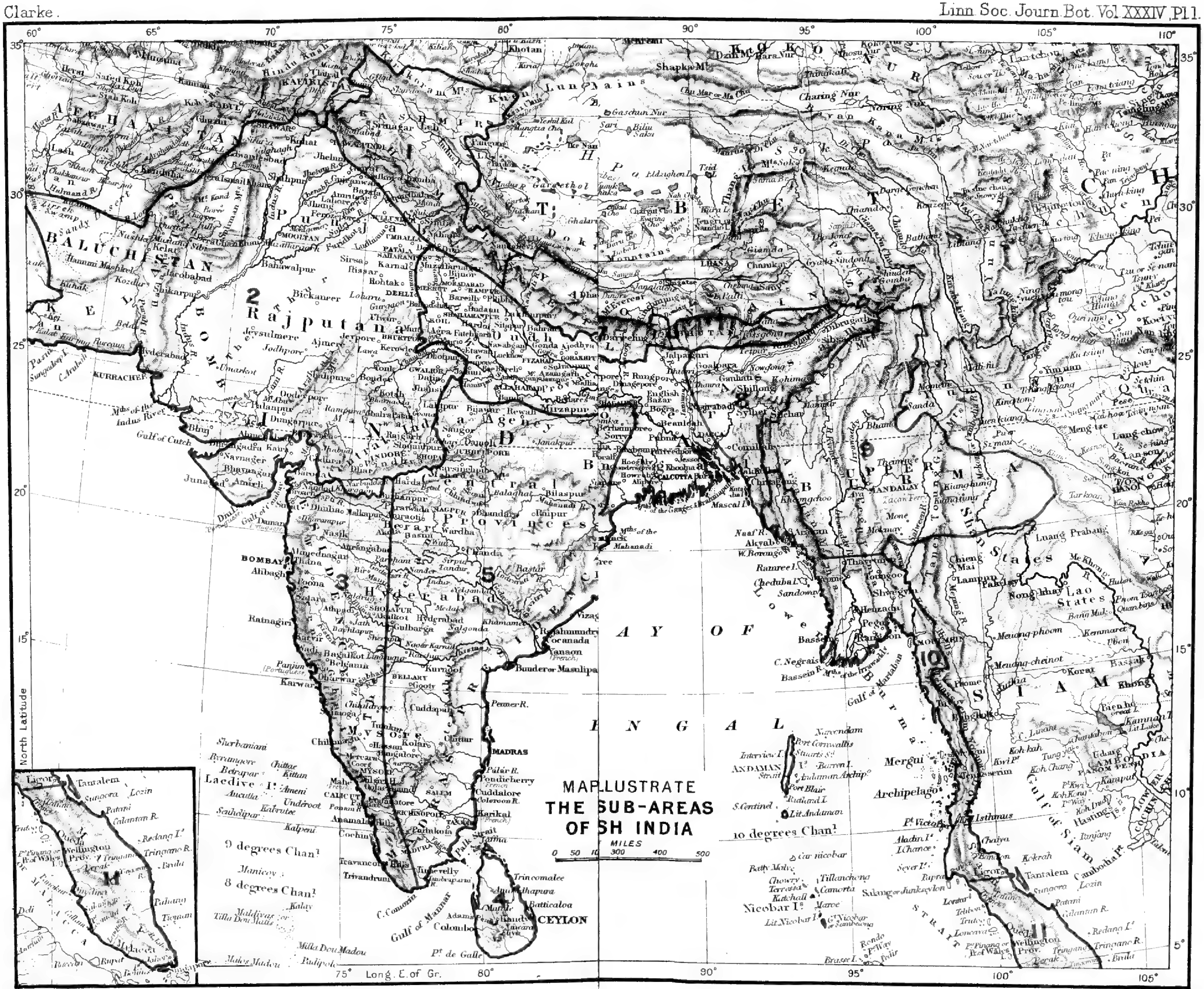
(1) West Himalaya.
(2) India Deserta.
(3) Malabaria.
(4) Ceylon.
(5) Coromandelia.
(6) Gangetic Plain.
(7) East Himalaya.
(8) Assam.
(9) Ava.
(10) Pegu.
(11) Malay Peninsula.

It is unnecessary to write out fully the boundaries of these subsubareas, as the Map shows them more quickly. But I may here explain the reasons why some of the lines are drawn where they are:—

(1) The eastern boundary of this subsubarea in Nepal is 80° 30′ Long. E. It is so drawn in order that Wallich's own collections made with his headquarters at Katmandu may go with Hooker's Tambur plants, and may be tabulated separately from the plants Wallich got from Kumaon, with which last go Duthie's West Nepal plants.

The south boundary is supposed the line between the hills and the plains, say the line of 1500 feet above sea.

(2) The subsubarea is essentially that of the Indian Desert, the Punjab Plain, Sindh and Beloochistan. Gujarat is supposed wholly in Malabaria, Malwa wholly in subsubarea (2), which also takes in Quetta and Kuram.


MAP LLUSTRATE
THE SUB-AREAS
OF SH INDIA
MILES
0 50 10 300 400 500
Long. E. of Gr.
North Latitude
60° 65° 70° 75° 80° 85° 90° 95° 100° 105° 110°
35° 30° 25° 20° 15° 10° 5°
1
2
3
4
5
6
7
8
9
10
11
AFGHANISTAN
BALUCHISTAN
KAFIRISTAN
KASHMIR
Punjab
Rajputana
BOMBAY
Central India Agency
Central Provinces
Hyderabad
Mysore
Madras
Bengal
Oudh
Nepal
Bhutan
Tibet
China
Upper Burma
Lower Burma
Shan States
Lao States
Siam
Ceylon
Andaman Is.
Nicobar Is.
Laccadive Is.
Maldivas
Mergui Archipelago
Bay of Bengal
Gulf of Siam
Gulf of Martaban
Gulf of Cutch
Gulf of Manaar
9 degrees Chan.
8 degrees Chan.
10 degrees Chan.
Malacca
Penang
Wellington Prov.
Perak
Singapore
BOMBAY
CALCUTTA
MADRAS
KURRACHEE
DELHI
Srinagar
Lahore
Mooltan
Simla
Agra
Lucknow
Allahabad
Benares
Patna
Darjeeling
Shillong
Chittagong
Akyab
Rangoon
Mandalay
Bhamo
Moulmein
Tavoy
Nagpur
Poona
Goa
Karwar
Calicut
Cochin
Trivandrum
C. Comorin
Pondicherry
Colombo
Kandy
Trincomalee
Pt de Galle

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(**3**) The eastern boundary is 76° 30′ Long. E., as far south as Mysore town, whence the boundary is a line drawn from Mysore to Tinnevelly. I have, generally, tabulated plants labelled "Pulneys" in (**3**). Dindigal is of course in (**5**). The line from Mysore to Tinnevelly is artificial and not very satisfactory; it remains for some one to discover a better.

(**5**) The north boundary is the base of the hills which run east and west nearly parallel with the Ganges from Gwalior to Rajmahl at the great bend of the Ganges. Thus subsubareas (**3**) and (**5**) together include the Gondwana region of geologists (except the Aravalli Mts., from which I have hardly a plant). Mt. Aboo, not being in Gujarat, is tabulated in subsubarea (**2**).

(**6**) The Gangetic plain is a Hooker-and-Thomson area; it extends from Saharunpore to the sea, including the plain of Orissa. The Terai of Nepal and Sikkim is here supposed part of the East Himalaya (**7**).

(**8**) Assam is understood to be the political province, as bounded by the present "inner line" of the 16-mile-to-the-inch administration map; but excluding such portion as drains into the Irawaddi: *i. e.* Muneypore is in subsubarea (**9**). It is true that the administrative line which separates Goalpara from North Bengal is arbitrary; it does not appear possible to separate the Bruhmapootra Valley (of Assam) from North Bengal by any line that is not arbitrary.

(**9**) This area includes all Burma that is not in Pegu nor in Assam; and includes Muneypoor as being a side valley of the Irawaddi.

(**10**) The boundary-line between this and Ava is the boundary-line between Pegu and Burma in 1870 (and for some time before, and after); so that it coincides with the north boundary-line of Kurz's 'Forest Flora of Pegu.' The southern boundary, in the latitude of Junkceylan, is drawn to keep our subsubarea (**11**) identic with the "Malay Peninsula" of Sir G. King.

## Order CYPERACEÆ.

| *Suborders.* | | West Himalaya. 1 | India Deserta. 2 | Mala-baria. 3 | Ceylon. 4 | Coroman-delia. 5 | Gangetic Plain. 6 | East Himalaya. 7 | Assam. 8 | Ava. 9 | Pegu. 10 | Malay Peninsula. 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CYPEREÆ. | EU-CYPEREÆ ... | 218 | 84 | 131 | 109 | 474 | 263 | 65 | 279 | 14 | 199 | 141 | 1977 |
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| SCLERIEÆ....... . ............ | | 4 | 1 | 21 | 48 | 35 | 16 | 30 | 94 | 5 | 41 | 51 | 346 |
| CARICINEÆ ..................... | | 465 | 22 | 66 | 51 | 33 | 3 | 234 | 199 | 20 | 11 | 13 | 1117 |
| | | 981 | 210 | 411 | 406 | 1011 | 575 | 429 | 884 | 68 | 493 | 423 | 5891 |

## Tribe CYPEREÆ.

| | West Himalaya. 1 | India Deserta. 2 | Mala-baria. 3 | Ceylon. 4 | Coroman-delia. 5 | Gangetic Plain. 6 | East Himalaya. 7 | Assam. 8 | Ava. 9 | Pegu. 10. | Malay Peninsula. 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. *Kyllinga* ...........← | 20 | 4 | 6 | 7 | 30 | 22 | 5 | 12 | ... | 18 | 18 | 142 → |
| II. *Pycreus*....... ......← | 46 | 12 | 33 | 17 | 59 | 33 | 11 | 54 | 2 | 27 | 15 | 309 → |
| III. *Juncellus* ..... ......← | 13 | 12 | 5 | 2 | 19 | 21 | ... | 3 | 1 | 2 | 1 | 79 → |
| IV. *Cyperus* ...........← | 126 | 55 | 70 | 64 | 289 | 168 | 36 | 179 | 11 | 128 | 76 | 1202 → |
| V. *Mariscus* ...........← | 13 | 1 | 15 | 19 | 69 | 18 | 12 | 25 | ... | 20 | 31 | 223 → |
| VI. *Torulinium* ........← | ... | ... | ... | ... | ... | 1 | ... | ... | ... | 2 | ... | 3 → |
| VII. *Courtoisia* ........← | ... | ... | 2 | ... | 8 | ... | 1 | 6 | ... | 2 | ... | 19 → |
| | 218 | 84 | 131 | 109 | 474 | 263 | 65 | 279 | 14 | 199 | 141 | 1977 |

## Tribe SCIRPEÆ.

| | West Himalaya. 1 | India Deserta. 2 | Mala-baria. 3 | Ceylon. 4 | Coromandelia. 5 | Gangetic Plain. 6 | East Himalaya. 7 | Assam. 8 | Ava. 9 | Pegu. 10 | Malay Peninsula. 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VIII. *Eleocharis* ........← | 33 | 8 | 17 | 24 | 52 | 31 | 9 | 34 | 2 | 16 | 14 | 240 → |
| IX. *Fimbristylis* ......← | 90 | 40 | 86 | 83 | 212 | 118 | 30 | 132 | 13 | 133 | 75 | 1012 → |
| X. *Bulbostylis* ........← | 17 | 3 | 14 | 12 | 39 | 12 | 7 | 12 | 1 | 5 | 7 | 129 → |
| XI. *Scirpus* ...........← | 96 | 39 | 33 | 24 | 104 | 115 | 23 | 50 | 10 | 25 | 13 | 532 → |
| XII. *Eriophorum*........← | 40 | 10 | ... | ... | 3 | ... | 11 | 4 | 1 | ... | 1 | 70 → |
| XIII. *Fuirena* ...........← | 4 | 1 | 11 | 10 | 35 | 7 | 3 | 12 | 1 | 19 | 8 | 111 → |
| XIV. *Lipocarpha* ........← | 9 | ... | 5 | 5 | 14 | 3 | 6 | 20 | 1 | 3 | 6 | 72 → |
| | 289 | 101 | 166 | 158 | 459 | 286 | 89 | 264 | 29 | 201 | 124 | 2166 |

## Tribe SCHŒNEÆ.

| | West Himalaya. 1 | India Deserta. 2 | Mala-baria. 3 | Ceylon. 4 | Coromandelia. 5 | Gangetic Plain. 6 | East Himalaya. 7 | Assam. 8 | Ava. 9 | Pegu. 10 | Malay Peninsula. 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XV. *Rynchospora* ...← | ... | ... | 19 | 16 | 6 | 6 | 9 | 33 | ... | 21 | 11 | 121 → |
| XVI. *Schœnus* ........← | ... | 2 | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 4 → |
| XVII. *Cladium* ........← | 4 | ... | ... | 5 | ... | 1 | ... | 1 | ... | ... | 9 | 20 → |
| XVIII. *Microschœnus* ...... | 1 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 |
| XIX. *Lepidosperma* ...... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 2 → |
| XX. *Gahnia* ........... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 10 | 10 → |
| XXI. *Remirea* ........← | ... | ... | 1 | 3 | 2 | ... | ... | ... | ... | 5 | 2 | 13 → |
| | 5 | 2 | 20 | 24 | 8 | 7 | 9 | 34 | | 26 | 36 | 171 |

### Suborder MAPANIÆ.

| | West Himalaya. 1 | India Deserta. 2 | Mala-baria. 3 | Ceylon. 4 | Coroman-delia. 5 | Gangetic Plain. 6 | East Himalaya. 7 | Assam. 8 | Ava. 9 | Pegu. 10 | Malay Peninsula. 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XXII. *Hypolytrum* ...← | ... | ... | 7 | 8 | 2 | ... | 2 | 11 | ... | 13 | 18 | 61 → |
| XXIII. *Thoracostachyum* . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 13 | 13 → |
| XXIV. *Mapania*........ ← | ... | ... | ... | 3 | ... | ... | ... | 3 | ... | 2 | 19 | 27 → |
| XXV. *Scirpodendron*...... | ... | ... | ... | 2 | ... | ... | ... | ... | ... | ... | 4 | 6 → |
| XXVI. *Lepironia* ......← | ... | ... | ... | 3 | ... | ... | ... | ... | ... | ... | 4 | 7 → |
| | | | 7 | 16 | 2 | | 2 | 14 | | 15 | 58 | 114 |

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| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | ***Indicæ* ......... | 36 | 2 | 42 | 29 | 32 | ... | 97 | 107 | 7 | 11 | 13 | 376 |
| | ****Atratæ*......... | 71 | 2 | ... | ... | ... | ... | 20 | ... | ... | ... | ... | 93 |
| | *****Propriæ* ...... | 167 | 11 | 8 | 10 | ... | 3 | 50 | 40 | 5 | ... | ... | 294 |
| | | 403 | 22 | 66 | 51 | 33 | 3 | 215 | 199 | 20 | 11 | 13 | 1036 |

The geographic localities for the Cyperaceæ which follow are arranged by, and the names cited from, Hooker's 'Flora of British India'—a very few corrections and additions, which have come to hand since the publication of vol. vi. of that work, have been made.

In the numerical tables, in place of the usual asterisk to denote the occurrence of a species, a number is put which indicates all that the asterisk would indicate, and is the number of localities cited in the list of localities.

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1. KYLLINGA TRICEPS, *Rottb.*; *Hook. f. Fl. Brit. Ind.* vi. 587.

**1.** Mussoorie, *Royle*, 188; Dehra Doon, *King*, 54, 60.

**4.** Ceylon, *Thwaites*, 3234; Colombo, *Beckett*, 2496.

**5.** Pondicherry, *Commerson*, 120, *Perrottet*, 524. Coromandel, *Bélanger*, 186. Madras Peninsula, *Wallich*, 3445 A, B, E (hb. propr.), *Wight*, 1852, 1852 *b* (hb. propr.), 1849 (hb. Calcutta). Chota Nagpore, alt. 1000 feet, frequent, *C. B. Clarke*. Gwalior, *Maries*, 378.

**6.** Moradabad, *T. Thomson*, 257, *Jacquemont*, 499 (399 in hb. Paris). Behar, *Hope*; Monghyr, *Buchanan Hamilton*, 213. Bengal, *Wallich*; Monghir, *Wallich*, 3445 C (hb. propr.), D (hb. Kew). Calcutta, *Wallich*, 370 (hb. Paris, *Delessert*).

**10.** Burma, *Wallich*, 3443 I (hb. propr.).

***Distrib.*** Ethiopia. Macao.

2. KYLLINGA CYLINDRICA, *Nees*; *Hook. f. l. c.* vi. 588.

**1.** Kumaon, *Strachey & Winterbottom*; Mussoorie, *Royle*, 39. Nepal, *Wallich*, 3442 partly (hb. propr.).

**3.** Canara, *Metz*, 827 *a*. Nilgiri Mts., *King*.

**5.** Maisor and Carnatic, *G. Thomson*, 28. Madras, *Wallich*, 3443 B (hb. Calcutta). Nundydroog, *Wallich*, 3443 D partly (hb. propr.). Chota Nagpore: Parasnath, *T. Anderson*.

**7.** Sikkim, alt. 2000 feet, *C. B. Clarke*, 35479.

**8.** Khasia, alt. 5000 feet, *C. B. Clarke*, 38909. Chittagong, *Hook. f. et T. Thoms.*

**11.** Singapore, *Hullett*, 495.

***Distrib.*** Ethiopia. Queensland, New South Wales.

3. KYLLINGA MELANOSPERMA, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 588.

**3.** Nilgiri Mts., *Leschenault*, *Perrottet*, 678, 1212; alt. 5000 feet, *C. B. Clarke*, 10884.

**4.** Ceylon, *Gardner*, 966; Central Province, alt. 4000-6000 feet, *Thwaites*, 818, 2980 (819 in hb. Boissier).

**5.** Madras Peninsula, *Wallich*, 3440 (hb. propr.), *Wight*, 2879, 2880, 1850 (in hb. Kew, Calcutta, *Delessert*, not in hb. propr.), 1851. Central India: Panchmari, *Duthie*, 10589.

**11.** Singapore, *Kurz*.

*Distrib.* Ethiopia. Madagascar. Malaya.

4. KYLLINGA BREVIFOLIA, *Rottb.*; *Hook. f. l. c.* vi. 588.

**1.** Rawul Pindee, *Aitchison*, 240. Mussoorie, *Royle*, 38. Kumaon, *Duthie*, 3459. Gurhwal, alt. 6000 feet, *Duthie*, 5002. Bheem Tal, *T. Thomson*. Nepal, *Wallich*, 3442 partly (hb. propr.).

**2.** Sind, *Pinwill*. Mt. Aboo, *G. King*.

**4.** Ceylon (frequent), *Thwaites*, 3755.

**5.** Nundydroog, *Wallich*, 3443 D partly (hb. propr.). Madras, *Wallich*, 3443 C (hb. propr.), *Wight*, 1849 partly, 1850 partly. Chota Nagpore, frequent, *C. B. Clarke*.

**6.** Bengal, *Buchanan Hamilton*, 211, *Wallich*, 3443 F partly, H partly (hb. propr.), 3444 *a* (hb. Delessert); common, *C. B. Clarke*.

**7.** Sikkim, Sonada, alt. 8000 feet, *Kurz*. East Himalaya, *Griffith*, Kew n. 6252, 6253.

**8.** Assam, frequent, *C. B. Clarke*. Upper Assam, *Griffith*, Kew n. 6254, 6255 partly. Khasia, *Hook. f. & T. Thoms.*, 28.

**10.** Burma, *Kurz*, 638, 639, 2718. Mergui, *Griffith*, Kew n. 6248 part, 6249, 6251. Wellesley, *G. King*. Andamans, *Kurz*. Nicobars, *Kurz*.

**11.** Penang, *Delessert*, *Didrichsen*, 3557. Malacca, *Griffith*, Kew n. 6247, 6250, *Jagor*, 307. Singapore, *Kurz*, 2997, 2998, *Ridley*, 33, 81.

*Distrib.* Ethiopia. Indo-China. Oceania. Florida. Bermuda. Neotropica.

5. KYLLINGA MONOCEPHALA, *Rottb.*; *Hook. f. Fl. Brit. Ind.* vi. 588.

  **1**. Mussooree, *Royle*, 37.
  **2**. Punjab, *T. Thomson.*
  **4**. Ceylon (common), *Thwaites*, 3753.
  **5**. Coromandelia, *Bélanger*, 185. Madras, *Wallich*, 3443 A, B (hb. propr.), *Wight*, 1849 partly; Mangalore, *Metz*, 199 *a*.
  **6**. Saharunpore, *Duthie.* Behar, *Buchanan Hamilton*, 212. Bengal, *Wallich*, 3443 F partly, H partly (hb. propr.), 3443 D (hb. Kew, Calcutta, DC.), 3443 H (hb. Mus. Brit.); frequent, *C. B. Clarke*; Calcutta, *Helfer*, 59, *Kamphoevener*, 502.
  **7**. Sikkim, alt. 6000 feet, *T. Anderson*, 263.
  **8**. Assam, *Griffith*, Kew n. 6255 mainly, *Jenkins*, 219, 223, frequent, *C. B. Clarke.* Khasia, alt. 2500–4500 feet, *Schlagintweit*, 141. Bengal Orient., *Griffith*, Kew n. 6254/1.
  **10**. Burma, *Griffith*, Kew n. 6248 partly, *Kurz*, 639, 663. Mergui, *Griffith*, 98. Andamans, *Kurz.* Nicobars, *Kamphoevener*, 2350, *Jelinski*, 198, 216.
  **11**. Penang, *Delessert*, *G. King.* Malacca, *Delessert*, *Yvan.* Singapore, *Wallich*, 3443 G (hb. propr.), *Kunstler*, 42, *Ridley*, 48.

*Distrib.* Ethiopia. Indo-China. Oceania. [In Neotropica very rarely collected.]

6. KYLLINGA SQUAMULATA, *Vahl*; *Hook. f. l. c.* vi. 589.

  **1**. Kashmir, *T. Thomson*, 1258, alt. 4000 feet, *C. B. Clarke*, 22792, 31569. Kumaon, alt. 5500 feet, *Strachey & Winterbottom*, *Duthie*, 6073. Gurhwal, 5500 feet, *Duthie*, 5001.
  **2**. Mt. Aboo, *G. King.*
  **3**. Canara, *Metz*, 199.

*Distrib.* North Trop. Africa, frequent. Martinique.

1. PYCREUS FLAVESCENS, *Reichb. Fl. Excurs.* (1830–2) p. 72; [*Nees*; *Hook. f. l. c.* vi. 589].

  **1**. Kurrum Valley, *Aitchison*, 964.

*Distrib.* Palæarctica. Ethiopia. U.S. Orient. Neotropica.

**2.** Pycreus stramineus, *C. B. Clarke*; *Hook. f. Fl. Brit. Ind.* vi. 589.
   **4.** Ceylon, *Thwaites*, 3776.
   **5.** Madras, *Wallich*, 3320 A part. Mangalore, *Hohenacker*, 302.
   **6.** [Bengal], *Wallich*, 3318 part. Calcutta, *C. B. Clarke*. Mymensingh, *C. B. Clarke*. Jumalpore, *Griffith*, Kew n. 6217.
   **8.** Khasia, *Hook. f. et T. Thoms.* Sylhet, *Wallich*, 3320 B. Silchar, *J. D. Hooker*. Chittagong, *J. D. Hooker*, 158.
   **10.** Arracan, *Kurz*, 676. Mergui, *Griffith*, 166, Kew n. 6169. Moulmein, *Philipps*. Tavoy, *Wallich*, 209 (hb. propr. not of List).
  *Distrib.* Endemic in India.

**3.** Pycreus latespicatus, *C. B. Clarke in Hook. f. l. c.* vi. 590.
   **1.** Kumaon, alt. 5000–6000 feet, *Strachey & Winterbottom*, *Duthie*, 3455.
   **3.** Malabar (vel Concan), *Stocks* (vel *Law*).
   **5.** Central India, Sumbulpore (herb. Calcutta). Chota Nagpore, alt. 1500–2500 feet (plentiful), *C. B. Clarke*.
   **7.** Sikkim Terai, *Kurz*.
   **8.** Assam, *J. D. Hooker*, 1482, alt. 3000–5500 feet, *Griffith*, 506, Kew n. 6200 part, (frequent) *C. B. Clarke*.
  *Distrib.* Endemic in India.

***3.** Pycreus malabaricus, sp. nov.

Radices fibrosæ. Culmi cæspitosi, pedales, graciles. Folia cum $\frac{2}{3}$ parte culmi æquilonga, $\frac{1}{12}$ unc. lata, debilia. Umbella e 1–3 spicis structa, 1 unc. in diam., 3–11-stachya; bracteæ 3, cum foliis similes, ima usque ad $3\frac{1}{2}$ unc. longa. Spiculæ distantes, $\frac{1}{2}$ unc. longæ, $\frac{1}{8}$ in. latæ, 20-floræ, multum compressæ, lateribus exacte parallelis. Glumæ naviculares, rigide accumbentes, vix acutæ, nitide nigræ marginibus anguste albis. Stylus 2-fidus. Nux ovoidea, lateraliter compressa, cum $\frac{3}{5}$ parte glumæ æquilonga, transversim crebre lineolata cellulis extimis longitudinaliter oblongis.

   **3.** Malabar Ghats, Lanowlee, *Woodrow*, 28 B.
  *Distrib.* Endemic in Malabaria.

**4.** Pycreus sanguinolentus, *Nees*; *Hook. f. l. c.* vi. 590.
   **1.** Baltisthan, alt. 7500 feet, *Schlagintweit*, 792, 1917, 5760, *C. B. Clarke*, 30021. Kashmir, *T. Thomson*; alt. 7500 feet,

*Levinge, W. S. Atkinson*; Kishtwar, *Schlagintweit*, 5112. Punjab, *Jacquemont*, 432, 437, *T. Thomson*; Rawul Pindee, *Aitchison*, 241. Kumaon, *Wallich*, 3319 G, *T. Thomson*, 1078, *Strachey & Winterbottom*, 5. Gurhwal, alt. 6000 feet, *Duthie*, 4481; Mussoorie, *Royle*, 24; Nagkunda, *Royle*, 30. Nepal, *Wallich*, 3319 H.

2. Sind, *Pinwill*. Mt. Aboo, *G. King*, *Duthie*, 6722.
3. Bombay, Kalyan, *Woodrow*, 11. Nilgiri Mts., *Hohenacker*, 946 part.
4. Central Province, *Thwaites*, 802, *Walker*.
5. Madras Peninsula, *Wallich*, 3319 A, B part, D. Chota Nagpore, alt. 1750 feet, *C. B. Clarke*.
6. Bengal, *Wallich*, 3319 C, E. Sahebgunj, *Kurz*. Dacca, *C. B. Clarke*. Mymensingh, *C. B. Clarke*.
7. East Himalaya, *Griffith*, Kew n. 6201. Sikkim Terai: Balasun R., alt. 500 feet, *C. B. Clarke*. Lachen, alt. 10,000 feet, *J. D. Hooker*.
8. Assam, *Griffith*, 1458, 1468, *Masters*, 572, *Jenkins*, 195, 196; Gowhatty, *Simons*. Khasia, alt. 0–5000 feet, *J. D. Hooker*, (frequent) *C. B. Clarke*. East Bengal, *Wallich*, 3344 B, *Griffith*, Kew n. 6187, 6200 part. Sylhet, *Wallich*, 3319 F, *J. D. Hooker*. Chittagong, *Hook. f. et T. Thoms.*, 57.
9. Ava, *Wallich*, 3335.
10. Pegu, *Kurz*, 624; Rangoon, *MacClelland*; Tavoy, *Wallich*, 265 (hb. propr. not of List).
11. Pahang, *Ridley*, 2144.

*Distrib.* Cabul. Central Asia. China. Japan. Malaya. Australia. Timor.

5. **Pycreus nitens**, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 591.

1. Kumaon, alt. 3500 feet, *Strachey & Winterbottom*, 3, *Duthie*, 3456; Dehra Dhoon, *G. King*. Gurhwal, alt. 5500 feet, *Duthie*, 4485. Nepal, *Wallich*, 3312 C.
2. Punjab, *T. Thomson*. Sind, *Pinwill*. Mt. Aboo, *Stocks*, 202, *G. King*.
3. Malabar, *Bélanger*, 233, 234. Canara, *Hohenacker*, 825, 826; Bababoodun Hills, *Law*. Nilgiri Mts., *G. Thomson*, 124.
4. Ceylon, *Thwaites*, 806, *Beckett*, 2541.
5. Madras Peninsula, *Wight*, 1809, *Wallich*, 3312 D part.

K, L, 3313 B part, 3339, *G. Thomson*, 179. Chanda, *Duthie*, 9823. Chota Nagpore, alt. 2000 feet, frequent, *C. B. Clarke*.

**6.** Moradabad, *T. Thomson*, 776. Behar, *Buchanan Hamilton*, 132, 137, 138, 144 part, *Wallich*, 3312 E. Lower Bengal, *Wallich*, 3312 A, B, F, G part, 3376 part; 24 Pergunnahs, *C. B. Clarke*.

**7.** Sikkim, *G. King*; Sookna, *C. B. Clarke*.

**8.** Assam, *Jenkins*, 199, *Griffith*, 1586. East Bengal, *Griffith*, Kew n. 6186, *J. D. Hooker*. Khasia, alt. 5500 feet, *Schlagintweit*, 135. Chittagong, *J. D. Hooker*, 151. Cachar, *Keenan*.

**10.** Rangoon, *Wallich*, 3312 H, *R. Scott*. Burma, *Griffith*, Kew n. 6186. Tavoy, *Wallich*.

**11.** Tenasserim, *Helfer*, Kew n. 6209/2. Penang, *Curtis*, 1782. Singapore, *Kunstler*, 62.

*Distrib.* Trop. Africa. China. Malaya. Trop. Australia.

6. PYCREUS PUMILUS, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 591.

**3.** Bombay, in the suburb Sion, *Woodrow*.

**5.** Madras Peninsula, *Leith*, 25 (in hb. Linn. propr.); Monamputta, in a rice-field, *Wight*, 1808, 2864, *Wallich*, 3336 C part.

*Distrib.* Mozambique. North Madagascar. Timor.

7. PYCREUS GLOBOSUS, *Reichb. Fl. Excurs.* (1830–2), Add. p. 140–10.

[*P. capillaris*, Nees; Hook. f. l. c. vi. 591.]

**1.** Kashmir, *Schlagintweit*, 5113, *Jacquemont*, 819; Rajaori, alt. 2500 feet, *Schlagintweit*, 12, 207. Baltisthan, Iskardo, *T. Thomson*; Shigar, alt. 8000 feet, *C. B. Clarke*. Rawul Pindee, *Aitchison*, 243, 247. Kunawur, *Jacquemont*, 1149. N.W. Himalaya, up to 6500 feet, *T. Thomson*, Kumaon, *Wallich*, 3318 C. Almora, *Strachey & Winterbottom*, 6. N.W. India, *Royle*, 7. Nepal, *Wallich*, 3318 D.

**2.** Punjab, *Schlagintweit*, 10186. Dera Ismail Khan, *Duthie*, 7937.

**3.** Nassik, *Kuntze*,

**5.** Chota Nagpore, alt. 750–2000 feet, plentiful, *C. B. Clarke*.

**6.** Moradabad, *T. Thomson*. Behar, *J. D. Hooker*.

**7.** Sikkim, *J. D. Hooker*. Darjeeling, *Griffith*, Kew n. 6191; Dalkajhar, alt. 400 feet, *C. B. Clarke*.

8. Upper Assam, *Jenkins*, 571, 574; Dihing R., *Griffith*, Kew n. 6182. Assam, *Mack*, *G. Mann*, 372. East Bengal, *Griffith*, Kew n. 6189 (6191 in hb. Berlin). Khasia, *J. D. Hooker*; alt. 3000–5000 feet (black chestnut spikelets), *J. D. Hooker*, 580, *Griffith*, Kew n. 6182, *Schlagintweit* 137; frequent, *C. B. Clarke*.

10. Nicobars, *Kurz*.

*Distrib.* Mediterranea. Central Asia. Mascarenia. China. Japan. Malaya. Australia. Timor.

PYCREUS GLOBOSUS, *Reichb.*:

Var. β. NILAGIRICA, *C. B. Clarke*; *Hook. f. Fl. Brit. Ind.* vi. 592.

3. Bombay, Heura, *Dalzell*. Poona, *Jacquemont*. Malabar, *Stocks, Law*. Canara, *Young*. Nilgiri Mts., *Hochstetter*, 945–945 *a*, *G. Thomson*, 20, 52, *Wight*, 1812, 2875.
4. Ceylon, *Gardner*, 954, 955; "very common," *Thwaites*, 801.
5. Tuticorin, *Wight*, 2878. Madras Peninsula, *Wallich*, 3310, 3318 A, B. Hyderabad, *Campbell*. Chanda, *Duthie*, 9821.

*Distrib.* Africa Trop. Bourbon. China. Japan. Malaya. East Australia.

PYCREUS GLOBOSUS, *Reichb.*:

Var. γ. STRICTA, *C. B. Clarke*; *Hook. f. l. c.* vi. 592.

1. Kishtwar, *Schlagintweit*, 3715. Kumaon, alt. 5000 feet, *Duthie*, 4489. Nepal, *Wallich*, 3385, 3318 D.
2. Punjab, *Stewart*, 293, 796.
3. Poona, *Jacquemont*, 276.
5. Chota Nagpore, *Wood*.
6. Moradabad, *T. Thomson*, 193. Purneah, *Buchanan Hamilton*, 144 part; Nathpur, *Wallich*, 3312 G part. Lower Bengal, *Wallich*, 3318 E, 3319 B part.
7. Bhotan, alt. 3500 feet, *Gamble*, 9598.
8. Assam, *Griffith*, 1022, *Jenkins*. Chittagong, at the burning spring, *J. D. Hooker*.

*Distrib.* Susiana. Ethiopia. China. Luzon.

PYCREUS GLOBOSUS, *Reichb.*:

Var. δ. ERECTA, *C. B. Clarke* (var. nova): stem and leaves more robust; umbel compound, rays of the secondary umbels 3–5 up to $\frac{1}{2}$–$\frac{3}{5}$ in. long; spikelets rather smaller, pale.—*Cyperus erectus* (sp.), Roxburgh MS.

**5.** Coromandelia, *Koenig*, *Roxburgh*.

*Distrib.* Formosa.

8. PYCREUS POLYSTACHYUS, *Beauv.*; *Hook. f. Fl. Brit. Ind.* vi. 592.

**2.** Sind, *Pinwill*.

**3.** Malabar, *Bélanger*, 225.

**4.** Ceylon. "Very abundant." *Thwaites*, 800, *Walker*, 49.

**5.** Madras, *Griffith*, 109. Madras Peninsula, *Rottboell*, *Wight*, 1811, *Wallich*, 3340 A, B, C, 3333, 3332 B part, 3320 A part. Pondicherry, *Perrottet*; Palaveram, *G. Thomson*.

**6.** Orissa, Poori, *W. S. Atkinson*. Lower Bengal, *Wallich*, 3340 D; Soondreebun, frequent, *C. B. Clarke*.

**8.** Sylhet, *Hook. f. & T. Thoms.* Cachar, *Keenan*. Chittagong, *C. B. Clarke*.

**10.** Burma, *Griffith*, Kew n. 6192, 6205. Andamans and Nicobars, *Kurz*.

**11.** Malacca, *Griffith*. Perak, *Wray*, 778. Singapore, *Kurz*, 3013, *Ridley*, 80, 1784, 1864, *Wichura*, 698 *a*.

*Distrib.* Mediterranea. Ethiopia. Indo-China. Florida. Neotropica.

PYCREUS POLYSTACHYUS, *Beauv.*:

Var. LAXIFLORA, *Benth.*; *Hook. f. l. c.* vi. 592.

**3.** Anamallay Mts., *Beddome*.

**4.** Ceylon, *Walker*, 23, 43, *Wight*, 2055.

**5.** Madras Peninsula, *Wallich*, 3332 B (in hb. propr.), C (in hb. Kew), 3331.

**8.** Chittagong, *J. D. Hooker*, 402.

**10.** Mergui, *Griffith*, 70, 290, Kew n. 6184. Andamans, *Kurz*.

**11.** Penang, *Curtis*, 1862. Malacca, *Griffith*, Kew n. 6205. Singapore, *Lobb*, *Ridley*, 1750.

*Distrib.* Ethiopia. Malaya. N.W. Australia. Sandwich Isles. United States. Neotropica.

9. PYCREUS FERRUGINEUS, *C. B. Clarke in Hook. f. l. c.* vi. 593.

**5.** Madras Peninsula, *G. Thomson*, 70. Mysore, *Rottler*.

*Distrib.* Ethiopia. Eastern North America. Central America.

10. PYCREUS SULCINUX, *C. B. Clarke in Hook. f. l. c.* vi. 593.

**3.** Anamallay Mts., alt. 3500 feet, *Beddome*.

**7.** North Bengal, alt. 1000–5000 feet, frequent, *C. B. Clarke.*

**8.** East Bengal, alt. 1000–5000 feet, frequent, *C. B. Clarke.* Assam, *Griffith*, 1601.

**10.** Pegu, *Kurz*, 659, *Oates.* Moulmein, *Helfer*, 326. Tenasserim, *Helfer*, Kew n. 6209/4.

*Distrib.* Nyasa-land. Borneo. Philippines.

11. PYCREUS ANGULATUS, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 593.

**1.** Nepal, *Wallich*, 3324 A.

**3.** Nilgiri Mts., *Wight*, 2874.

**6.** Dinajpore (floating), *C. B. Clarke.*

**8.** Assam, *Masters*, 198. Khasia, *Griffith*, 1327, alt. 3000–5500 feet, *Hook. f. & T. Thoms.*, frequent, *C. B. Clarke.*

**9.** Ava, *Wallich*, 3324 B.

*Distrib.* Zambesia. Caput. Australia. Neotropica.

PYCREUS ANGULATUS, *Nees*:

Var. β. WIGHTII, *C. B. Clarke in Hook. f. l. c.* vi. 593.

**5.** Madras Peninsula, *Wight*, 2875, 2874 (in herb. Berlin).

*Distrib.* Endemic.

12. PYCREUS BACCHA, *Nees in Linnæa*, ix. [1834] 283.

[*P. puncticulatus*, C. B. Clarke in Hook. f. l. c. vi. 593.]

**3.** Londa, *Cooke.*

**4.** Ceylon, *Thwaites*, 3316 (hb. Kew, Mus. Brit.), 3751 Damboul, *Beckett.*

**5.** Madras Peninsula, *Rottler, Wallich*, 3336 A, D, F, C part, 3355 B part, 3337 part (in hb. Kew), *Wight*, 1813 (in hb. propr.), 2871.

*Distrib.* Chefoo.

PYCREUS BACCHA, *Nees*:

Var. QUINQUAGINTIFLORA, *C. B. Clarke in Hook. f. l. c.* vi. 594.

**5.** Madras Peninsula, *Wallich*, 3336 B.

*Distrib.* Endemic.

13. PYCREUS ALBOMARGINATUS, *Nees*; *Hook. f. l. c.* vi. 594.

**3.** Concan and Malabar, *G. Thomson, Stocks, Beddome.*

**10.** Rangoon, *R. Scott, Kurz.*

*Distrib.* Ethiopia. North Australia. New Mexico. Neotropica.

1. **JUNCELLUS SEROTINUS**, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 594.

**1.** Kashmir, *Jacquemont*, 1138, *W. S. Atkinson*, 24199. Chumba, alt. 3500 feet, *C. B. Clarke*, 24276, 24696. Rawal Pindee, *Aitchison*, 246.

**2.** Punjab, Chenab R., *T. Thomson*, 1589.

*Distrib.* Palæarctica. China. Japan.

2. **JUNCELLUS STYLOSUS**, *C. B. Clarke in Hook. f. l. c.* vi. 595.

To be wiped out! The single sheet on which the species is founded is *Pycreus umbrosus*, Nees (a South African plant); it is marked in herb. Kew "Khasya Hills, Griffith." I have no doubt that this locality is some herbarium error that was introduced at the time of pasting down.

3. **JUNCELLUS INUNDATUS**, *C. B. Clarke in Hook. f. l. c.* vi. 595.

**6.** Calcutta, *Buchanan Hamilton*, 163, *Wallich*, 3342 A, B, C part, *Kurz*; Hooghly, *Wallich*, 1197 (in hb. Mus. Brit.); Jheels, *T. Anderson*.

**8.** Sylhet, *Wallich*, 3355 C.

*Distrib.* Mascarenia. China. Japan.

4. **JUNCELLUS ALOPECUROIDES**, *C. B. Clarke in Hook. f. l. c.* vi. 595.

**2.** Peshawur, *Griffith*, 199 *a*, Kew n. 6150. Chenab R., *T. Thomson*. N.W. India, *Royle*. Sind, *Stocks*.

**3.** Bombay, *Dalzell*, *Jacquemont*, 438. Poona, *Jacquemont*, 297. Canara, *Lélanger*, 224.

**4.** Batticaloa District, *Thwaites*, 3560.

**5.** Madras Peninsula, *Koenig*, *Heyne*, *Rottler*, *Wallich*, 671, 3344 A, B, C, *Wight*, 2877. Hyderabad, *Campbell*.

**6.** Moradabad, *T. Thomson*, 347. Delhi, *C. B. Clarke*, 23351. Bengal, *Wallich*.

**8.** East Bengal, *Griffith*, Kew n. 6155. Sylhet, *Hook. f. & T. Thoms.*

**11.** Penang and Kelantan, *fide Ridley*.

*Distrib.* Mediterranea. Ethiopia. Malaya. Queensland. Guadeloupe.

5. **JUNCELLUS PYGMÆUS**, *C. B. Clarke in Hook. f. l. c.* vi. 596.

**1.** Kashmir, *Jacquemont*, 1087. West Himalaya, *Royle*, 100.

**2.** Punjab, Chenab R., *T. Thomson*.

**3.** Bombay, *Law*.

**4.** Ceylon, *Thwaites*, 3947.

**5.** Madras Peninsula, *Wight*, 1807, 2307, 2862, *G. Thomson*, 177. Central India, Khandwa, *Duthie*, 8456.

**6.** Lucknow, *T. Anderson*, 14. Purneah, *C. B. Clarke*, 11740. Behar, *Schlagintweit*, 12946, *J. D. Hooker*. Bengal, *Roxburgh*, *Griffith*, Kew n. 6185, *Wallich*, 3325 B, C.

**9.** Ava, *Wallich*, 3495.

**10.** Pegu, *Kurz*, 646; Burma, *Wallich*, 3484.

*Distrib.* Mediterranea. North Trop. Africa. China. Japan. Malaya. Australia.

6. JUNCELLUS LÆVIGATUS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 596.

**1.** Rawul Pindee, *Aitchison*, 239. Bhimbur, *Stewart*, 799, 871. R. Jhelum, *Jacquemont*, 133. N.W. India, *Royle*, 5, 59.

**2.** Sind, *Pinwill*. Marwar, *G. King*. Rajpootana, *Duthie*, 4912.

**5.** Madras Peninsula, *Rottler*, *Wight* 2389, *Wallich*, 3311. Tuticorin, *Wight*, 2020. Bundelkund, *Duthie*, 6500.

**6.** Moradabad, *T. Thomson*. Meerut, *T. Thomson*, 104.

*Distrib.* Mediterranea. Ethiopia. China. West Australia. Sandwich Isles. West U. S. Neotropica.

JUNCELLUS LÆVIGATUS, *C. B. Clarke*:

Var. β. JUNCIFORMIS, *C. B. Clarke in Hook. f. l. c.* vi. 597.

**2.** Peshawur, *Stewart*. Sind, *Stocks*, 751.

*Distrib.* Mediterranea. Neotropica.

1. CYPERUS CEPHALOTES, *Vahl*; *Hook. f. l. c.* vi. 597.

**4.** Galle, *Thwaites*, 3221.

**5.** Madras Peninsula, *Heyne*, *Wallich*, 3441 A part, *Wight*, 1855, 2919 (in herb. Calcutta).

**6.** Lower Bengal, *Wallich*, 3441 C; frequent, *C. B. Clarke*.

**8.** Assam, *Griffith*, 1609, *Simons*, 26, frequent, *C. B. Clarke*. East Bengal, *Griffith*, Kew n. 6172, n. 6128/2, *J. D. Hooker*, frequent, *C. B. Clarke*. Cachar, *Keenan*. Sylhet, *Wallich*, 3441 D. Chittagong, *J. D. Hooker*.

**9.** Bhamo, *Griffith*, Kew n. 6172, *J. Anderson*.

**10.** Pegu, *Kurz*, 646 bis, 2670.

*Distrib.* Amoy. Malaya. Queensland.

2. CYPERUS PLATYSTYLIS, *R. Br.*; *Hook. f. Fl. Brit. Ind.* vi. 598.
   **4.** Ceylon, *Walker*; Batticaloa District, *Thwaites*, 3559.
   **5.** Madras Peninsula, *Heyne*, *Wallich*, 3336 B (in hb. Kew), 3337 A, B.
   **6.** Calcutta, *Gaudichaud*, 330. Serhampore, *Griffith*. Pirgunj, *Buchanan Hamilton*, *Wallich*, 3337 C. R. Megna, *J. D. Hooker*. Bengal, frequent, *C. B. Clarke*.
   **8.** Assam, *Simons*, 644, 645. East Bengal, *Griffith*, Kew n. 6158, n. 6158 bis (hb. Calcutta). Chittagong, *J. D. Hooker*, 139.
   **10.** Pegu, *Kurz*, 685, 686. Mergui, *Griffith*, Kew n. 6168 (hb. Calcutta).
   **11.** Penang, *Wallich*, 3359 D part.
   *Distrib.* Malaya. New South Wales.

3. CYPERUS AMABILIS, *Vahl*; *Hook. f. l. c.* vi. 598.
   **1.** Kumaon, *G. King*, *Duthie*, 6075. Naini Tal, *Davidson*.
   **5.** Chota Nagpore, alt. 500–2000 feet, frequent, *C. B. Clarke*.
   **6.** Moradabad, *T. Thomson*, 393.
   *Distrib.* Ethiopia. Chihuahua. Neotropica.

4. CYPERUS CASTANEUS, *Willd.*; *Hook. f. l. c.* vi. 598.
   **3.** Laddapore, *Cooke*.
   **4.** Ceylon, *Walker*, *Thwaites*, 803.
   **5.** Madras Peninsula, *Wight*, 1821, *Wallich*, 3323. Chota Nagpore, alt. 1750 feet, *C. B. Clarke*.
   **6.** Mymensingh, *C. B. Clarke*, 17294.
   **7.** R. Tambur, *J. D. Hooker*. Sikkim Terai, alt. 500 feet, *C. B. Clarke*.
   **10.** Pegu, *MacClelland*. Mergui, *Griffith*, 43. Tenasserim, *Helfer*, Kew n. 6202 (in hb. Leiden).
   **11.** Perak, alt. 700 feet, hb. *King*, 10805.
   *Distrib.* Tonkin. Central Australia.

5. CYPERUS UNCINATUS, *Poiret*, *Encyc.* vii. p. 247.
   [*C. cuspidatus*, H. B. K.; Hook. f. Fl. Brit. Ind. vi. 598.]
   **1.** Kashmir, alt. 4000 feet, *C. B. Clarke*, 31570. Dehra, *T. Thomson*; Ranikhet, *Duthie*, 6078. Nepal, *Wallich*, 3312 C part.
   **2.** Sind, *Pinwill*.
   **3.** Mangalore, *Metz*, 824.

**4.** Ceylon, *Beckett*, *Thwaites*, 803 (in hb. Mus. Brit.).

**5.** Madras Peninsula, *Wight*, 2337. Chota Nagpore, alt. 1000–2000 feet, *C. B. Clarke.* Central India, Chunda, *Duthie*, 9817.

**6.** Moradabad, *T. Thomson*, 321. Saharunpore, *Duthie*, 4487 *a*. Lucknow, *Bonavia*, 236. Monghir, *Buchanan Hamilton*, 135, *Wallich*, 3376 A part. Purnea, *Buchanan Hamilton*, 136. Lower Bengal, *Wallich*, 3376 B part.

**7.** Sikkim Terai, *J. D. Hooker*, alt. 500 feet, *C. B. Clarke*, 8529.

**8.** Assam, *Griffith*, 1594, *Jenkins*, 201. East Bengal, *Griffith*, Kew n. 6202, 6203/1. Khasia, alt. 2500 feet, *J. D. Hooker*, 1818, frequent, *C. B. Clarke.* Naga Hills, alt. 5000 feet, *C. B. Clarke.*

**10.** Pegu, *MacClelland.*

**11.** Penang, *Curtis*, 1831.

*Distrib.* Ethiopia. China. Malaya. Queensland. Timor. Florida. Neotropica.

6. CYPERUS FUSCUS, *Linn.*; *Hook. f. Fl. Brit. Ind.* vi. 599.

**1.** Kashmir, 6000 feet, *T. Thomson*; Kishtwar, 6000 feet, *C. B. Clarke*, 31383; Sreenuggur, *Schlagintweit*, 4310, 4473. North-west Himalaya, *T. Thomson.*

*Distrib.* Palæarctica.

7. CYPERUS DIFFORMIS, *Linn.*; *Hook. f. l. c.* vi. 599.

**1.** Kashmir, alt. 9000 feet, *Jacquemont*, 722, 827, *Schlagintweit*, 4225. Kumaon, *Wallich*, 3363 G. Dehra Dhoon, *Duthie*, 2395. Nepal, *Wallich*, 3363 H.

**2.** Lahore, *T. Thomson.* Sind, *Pinwill.* Mt. Aboo, *Duthie*, 6723.

**3.** Poona, *Jacquemont*, 275. Canara, *Hohenacker*, 821, *Talbot*, 1000.

**4.** Ceylon, *Koenig*, common, *Thwaites*, 3042.

**5.** Madras Peninsula, *Rottler*, *Wight*, 1842, 2884, *Wallich*, 3363 A, B, C, D. Pondicherry, *Perrottet.* Madras, *Griffith*, 104. Bababoodun Hills, *Law.* Hyderabad, *Campbell.* Central India, *King*, 49. Chota Nagpore, alt. 750–2500 feet, common, *C. B. Clarke.*

**6.** Moradabad, *T. Thomson*, 282. Saharunpore, *Royle*, 32. Indalpore, *Duthie*, 4479. Oudh, *R. Thompson*, 360.

Monghir, *Wallich*, 3363. Patna, *Buchanan Hamilton*, 154. Lower Bengal, *Wallich*, 3363 I.

**8.** Assam, *Masters*, 206. Now Dihing, *Griffith*, Kew n. 6165 part. Sylhet, *J. D. Hooker*. Chittagong, *J. D. Hooker*.

**9.** Ava, *Wallich*, 3363 K.

**10.** Pegu, *Kurz*, 657, 2678. Rangoon, *R. Scott*. Mergui, *Griffith*, Kew n. 6165 part. Tavoy, *Wallich*.

*Distrib.* Italy. Mediterranea. Ethiopia. Indo-China. Australia. Polynesia. Mexico.

8. CYPERUS SILLETENSIS, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 600.

**6.** North Bengal, *Buchanan Hamilton*, 155, *C. B. Clarke*, 12068, 26510. Dacca, *C. B. Clarke*, 6747, 6885.

**8.** Suddiya, *Griffith*, 1029, 1474, Kew n. 6212. East Bengal, *Griffith*, 1456, Kew n. 6166. Cachar, *Keenan*. Sillet, *Wallich*, 3363 F; Companigunj, *C. B. Clarke*, 42740.

**10.** Pegu, *Kurz*, 2679. Rangoon, *Cleghorn*, 215. Martaban, *Kurz*, 653.

*Distrib.* Endemic in Bengal, Assam, Pegu.

9. CYPERUS PULCHERRIMUS, *Kunth*; *Hook. f. l. c.* vi. 600.

**2.** Sind, *Pinwill*.

**4.** Ceylon, *Deschamps*; Batticaloa, *Thwaites*, 3558.

**6.** Bengal, *Wallich*, 3357.

**8.** Assam, *Jenkins*, 565; Súddiya, *Griffith*, 1035, 1480, Kew n. 6173.

**11.** Penang, *Curtis*, 1954. Selangor and Pahang, fide *Ridley*.

*Distrib.* Malaya.

10. CYPERUS HASPAN, *Linn.*; *Hook. f. l. c.* vi. 600.

**2.** R. Chenab, *T. Thomson*.

**3.** Canara, *Metz*, 691, *Hohenacker*, 187.

**4.** Ceylon, *Gardner*, 957, *Walker*, 19; abundant, *Thwaites*, 799, 805 part, 965.

**5.** Madras Peninsula, hb. *Heyne*, *Wallich*, 3369 D, *Wight*, 1822 *b*. Central India, *King*.

**6.** Saharunpore, *Royle*, 10. Monghyr, *Buchanan Hamilton*, 160; Nathpur, *Wallich*, 3369 G part; North Bengal, *Buchanan Hamilton*, 145. Serhampore, *Carey*.

**7** Sikkim, alt. 2000 feet, *King*, 4812.

**8** Assam, *Jenkins*, 740, *Griffith*, 1480, 1599. Khasia, *Griffith*, 520; alt. 5000 feet, frequent, *C. B. Clarke*. Sylhet, *Wallich*, 3368, 3372. Jumalpore, *Griffith*, Kew n. 6216. Jheels, *J. D. Hooker*, 276.

**10.** Pegu, *Kurz*, 677, 679, 681. Mergui, *Griffith*, 268, Kew n. 6216. Tavoy, *Wallich*, 3369 E, F. Tenasserim, *Helfer*, Kew n. 6216. Nicobars, *Kurz*, 25979.

**11.** Perak, *Wray*, 771, 2443. Singapore, *Kurz*, 140, *Kunstler*, 61.

*Distrib.* Ethiopia. Indo-China. Trop. Australia. East U. S. Neotropica.

11. Cyperus flavidus, *Retz.*; *Hook. f. Fl. Brit. Ind.* vi. 600.

**1.** Kashmir, *Jacquemont*, 1140. Kangra, alt. 3000 feet, *C. B. Clarke*, 24647. North-west India, *Royle*, 10. Nepal, *Wallich*, 3365 B.

**2.** Punjab, *T. Thomson*. Sind, *Pinwill*.

**3.** Canara, *Hohenacker*, 1607, 1670. Malabar, *Law*, *Bélanger*, 223.

**4.** Ceylon, *Thwaites*, 805 part.

**5.** Madras Peninsula, *Wight*, 1822, 2874, *Wallich*, 3369 A, B, 3365 A, 3313 part. Coromandel, *Bélanger*, 219. Chota Nagpore, alt. 2000 feet, *C. B. Clarke*, 20845, 25192, 33838, 33876, 34106. Chunda, *Duthie*, 9812, 9813, 9814, 9818. Bundelkund, *Duthie*, 6496, 6498.

**6.** Moradabad, *T. Thomson*, 785. Saharunpore. *T. Thomson*. Monghyr, *Wallich*, 3369 G part. Siligori, *O. Kuntze*. Lower Bengal, *Wallich*, 3369 C, frequent, *C. B. Clarke*. Burrisal, *C. B. Clarke*, 16947.

**8.** Assam, *Jenkins*, *Simons*. Naga Hills, alt. 400 feet, *C. B. Clarke*, 41550. Khasia, *Griffith*, 199, Kew n. 6209/5. Cachar, *C. B. Clarke*, 18568. Sylhet, *Wallich*, 3365 C. Chittagong, *J. D. Hooker*. Chittagong Hills, *Lister*.

**10.** Arracan, *Kurz*, 677.

**11.** Penang, *Curtis*, 1788 part.

*Distrib.* Ethiopia. Yokohama. Malaya. North Australia.

12. Cyperus Teneriffæ, *Poiret*; *Hook. f. l. c.* vi. 601.

**3.** Poona, *Woodrow*, 143. Nilgiri Mts., *Hohenacker*, 1293.

**5.** Madras Peninsula, *Rottler*, *Wallich*, 3314 A part & B (in hb. propr.), *Wight*, 1817, *Griffith*, 88 (in hb. Berlin). Carnatic, *G. Thomson*, 99.

*Distrib.* Mediterranea. Ethiopia.

13. Cyperus niveus, *Retz.*; *Hook. f. Fl. Brit. Ind.* vi. 601.

**1.** Kashmir: Bimbur, *W. S. Atkinson*, 24197: Kishtwar, alt. 8250 feet, *Stoliczka.* Rawul Pindee, *Aitchison*, 94. Simla, alt. 6000 feet, *Gamble*, 4458 B. Sirmoor and Kumaon, *Wallich*, 3377 E, F. Kumaon, alt. 6500 feet, *Strachey & Winterbottom*, 4. Gurhwal, *Duthie*, 71. Mussoorie, *Royle*, 8. Choor, *Royle*, 25. Nepal, *Wallich*, 3377 B.

**2.** Peshawur, *Stewart*, 289, 383, 782. Sind, *Pinwill.* Jodhpoor, *G. King.* Jullundur, *Jacquemont*, 951.

**5.** Madras Peninsula, *Wight*, 1818, *Campbell.* Aurungabad, *Hardwicke.* Chota Nagpore, *Wood*; frequent, *C. B. Clarke.*

**6.** Moradabad, *T. Thomson*, 212. Rajmahal, *Kurz.* Monghir, *Wallich*, 3377 A, C.

**7.** Darjeeling, alt. 6500 feet, *Schlagintweit*, 12516. Sikkim Terai, *J. D. Hooker*, *C. B. Clarke*, 35098, 35100, *G. King.*

**8.** Assam, *Griffith*, 1610, 1467 (hb. Mus. Brit.), *Fisher.* East Bengal, *Griffith*, Kew n. 6171.

**10.** Irrawaddi Bank, *Wallich*, 3377 D. Burma, *Griffith*, Kew n. 6170.

*Distrib.* Mediterranea. Szechuen.

14. Cyperus leucocephalus, *Retz.*; *Hook. f. l. c.* vi. 602.

**3.** Concan, Canara, and Mysore, *Law.*

**5.** Coromandelia, *Russell.*

**6.** Monghir, *Wallich*, 3445 D (in hb. propr.), 3445 C (in hb. Kew). Burdwan, Burrakur, *Kurz.*

**8.** Chundragona (in Chittagong ?), *Koenig.*

**10.** Pegu, *Kurz*, 647. Moulmein, *Helfer*, 295, 328, *Parish*, 66 mainly. Amherst, *Wallich.* Tenasserim, *Helfer*, Kew n. 6247/1.

*Distrib.* Africa Trop. Malaya. Trop. Australia. Brasil.

15. Cyperus arenarius, *Retz.*; *Hook. f. l. c.* vi. 602.

**2.** Sind, *Pinwill.* Kurrachee, *Stocks.* Punjab Plain, *Duthie*, 4491.

**3.** Bombay, *Dalzell.* Concan, *Law.* North Canara, *Talbot*, 553.

**4.** Batticaloa, *Gardner*, *Thwaites*, 798.

**5.** Madras Peninsula, *Rottler*, *Wight*, 1816 (8, 2920 in hb. Berlin), *Wallich*, 3460, 3435 (hb. propr.), 3314 A part (hb. propr., Kew), 3535 (hb. Mus. Brit.); Coloor, *G. Thomson*; Nellore, *Gamble*, 12395; Chingleput, *Gamble*, 17193. Orissa, *W. S. Atkinson*, 21729.

*Distrib.* Mediterranea.

16. CYPERUS CONGLOMERATUS, *Rottb.*; *Hook. f. Fl. Brit. Ind.* vi. 602.

**2.** Sind; Sibi, alt. 500 feet, *Lace*. Baluchisthan, *Elliott*.

*Distrib.* Mediterranea. North Trop. Africa.

17. CYPERUS PACHYRRHIZUS, *Boeck.*; *Hook. f. l. c.* vi. 603.

**3.** Bombay, *Woodrow*; Bhiwa, *Cooke*. Laccadive Isles, *Hume*.

**4.** Ceylon, *Thwaites*, 808, *Wight*, 2381; North Ceylon, *Gardner*.

*Distrib.* Endemic in South India.

18. CYPERUS EFFUSUS, *Rottb.*; *Hook. f. l. c.* vi. 603.

**2.** Sind, *Pinwill*.

*Distrib.* Mediterranea. North Trop. Africa.

19. CYPERUS ATKINSONI, *C. B. Clarke*; *Hook. f. l. c.* vi. 603.

**1.** Kashmir, Bimbur, *W. S. Atkinson*, 24196. North-west Himalaya, Kotgurh, *T. Thomson*.

**2.** Sind, Kurrachee, *Stocks*, hb. *Dalzell*.

*Distrib.* Endemic in North-west India.

20. CYPERUS DIFFUSUS, *Vahl*; *Hook. f. l. c.* vi. 603.

**4.** Kornegalle, *Thwaites*, 2879.

**5.** Madras Peninsula, *Rottler*, *Wallich*, 3362 B (hb. propr.), *Wight*, 1003, 2374 (hb. Berlin). Courtallum, *Wight*, 1004.

**6.** Lower Bengal, *Wallich*, 3358 B (hb. propr.).

**7.** Sikkim, *T. Anderson*, 1344; R. Rungait, *J. D. Hooker*; alt. 750–3000 feet, common, *C. B. Clarke*.

**8.** Assam, *Griffith*, 1605, Kew n. 6162, *Jenkins*, 574. Khasia, *Griffith*, Kew n. 6218, *J. D. Hooker*, 1902, *Wallich*.

Cachar, *Keenan*. Pundua, *J. D. Hooker*, 420. Chattuck, *Griffith*, Kew n. 6218. Chittagong, *J. D. Hooker*, 386.

**10.** Pegu, *Kurz*, 670 (hb. Hance). Rangoon, *Wallich*, 3362 A (hb. propr.). Moulmein, *Parish*, 294. Mergui, *Griffith*, Kew n. 6354. Tenasserim, *Helfer*, Kew n. 6161. Andamans, *Kurz*.

**11.** Penang, *Wallich*, 3370 A (hb. propr.). Malacca, *Griffith*.

*Distrib.* Ethiopia. China. Malaya. Polynesia. Neotropica.

21. CYPERUS PUBESQUAMA, *Steud.*; *Hook. f. Fl. Brit. Ind.* vi. 604.

**4.** Ceylon, *Thwaites*, 3931.

**8.** Assam, *Jenkins*. East Bengal, *Griffith*, Kew n. 6162. Garo Hills, alt. 1200 feet, *C. B. Clarke*, 42993. Khasia, *J. D. Hooker*; alt. 1000 feet, *C. B. Clarke*, 5468. Naga Hills, alt. 450 feet, *C. B. Clarke*, 37821, 40791. Cachar, *Keenan*. Chittagong, *C. B. Clarke*, 19689.

**9.** Bhamo, *J. Anderson*.

**10.** Arracan, *Kurz*. Burma, *Griffith*, 320, 324, Kew n. 6162. Tenasserim vel Andamans, *Helfer*, Kew n. 6164/1, *Packman*. Mergui Archipelago, *J. Anderson*.

**11.** Penang, *Wallich*, 3370 B (hb. propr.). Perak, *Wray*, 2247.

*Distrib.* Malaya. Polynesia.

22. CYPERUS HELFERI, *Boeck.*; *Hook. f. l. c.* vi. 604.

**10.** Pegu, *Kurz*, 2680. Burma, R. Chappedong, *Wallich*, 3528 (hb. propr.). Mergui, *Griffith*, 321, Kew n. 6140. Tenasserim vel Andamans, *Helfer*, Kew n. 6140.

*Distrib.* Endemic in Pegu.

23. CYPERUS MULTISPICATUS, *Boeck.*; *Hook. f. l. c.* vi. 604.

**8.** Cachar, *Keenan*.

**10.** Tenasserim vel Andamans, *Helfer*, Kew n. 6163.

*Distrib.* Endemic in Assam and Pegu.

24. CYPERUS KURZII, *C. B. Clarke*; *Hook. f. l. c.* vi. 604.

**10.** Andamans, Phaeacia, *Kurz*.

*Distrib.* Endemic in Andamans.

25. Cyperus bancanus, *Miq. Fl. Ind. Bat. Suppl.* [1860], pp. 260, 599.

[*C. turgidulus*, C. B. Clarke; Hook. f. Fl. Brit. Ind. vi. 604.]

**10.** Pegu, *Kurz*, 655. Martaban, *Kurz*. Moulmein, *Helfer*, 290, *R. Scott*. Mergui, *Griffith*, 88. Amherst, *Wallich*. Tenasserim, *Helfer*, Kew n. 6164. Tavoy and Penang, *Wallich*, 3473 (hb. propr.).

**11.** Penang, *Curtis*, 883. Malacca, *Griffith*, Kew n. 6164, *King*. Singapore, *Ridley*.

*Distrib.* Malaya.

26. Cyperus radians, *Nees*; *Hook. f. l. c.* vi. 605.

**10.** Tenasserim, *Helfer*, Kew n. 6209.

**11.** Penang, *Curtis*, 884. Malacca, *Griffith*, *Maingay*, 1721, 2987, 3191. Pahang, *Ridley*. Singapore, *Wallich*, 3427 (hb. propr.), 3371 B part (hb. propr.), *Ridley*, 1747.

*Distrib.* China. Malaya.

27. Cyperus compressus, *Linn.*; *Hook. f. l. c.* vi. 605.

**1.** Gurhwal, alt. 11,000 feet, *Schlagintweit*, 7841. Kumaon, alt. 5000 feet, *Duthie*, 4490. Dehra Dhoon, *Duthie*, 2110.

**2.** R. Chenab, *T. Thomson*. Sind, *Pinwill*.

**3.** Poona, *Woodrow*, 173. Canara, *Law*. Mangalore, *Metz*, 822.

**4.** Ceylon, *Moon*; very common, *Thwaites*, 812.

**5.** Coromandelia, *Bélanger*, 221. Madras, *Wight*, 1817. Madras Peninsula, *Wight*, 1814, 18 (hb. Berlin), *Wallich*, 3308 C, D, E (hb. propr.); Nondarada, *Rottler*; Carnatic, *G. Thomson*, 69. Mysore, *Law*. Central India, *G. King*. Chota Nagpore, *Wood*.

**6.** Moradabad, *T. Thomson*, 263. Saharunpore, *Royle*, 1. Oudh, *R. Thompson*, 409; Lucknow, *Bonavia*, 238. Nathpur, *Wallich*, 3314 C (hb. propr.). Lower Bengal, *Wallich*, 3308 B, common, *C. B. Clarke*; Calcutta, *C. B. Clarke*, 33602; Khoolna, *Griffith*, 167, Kew n. 6181.

**7.** Sikkim, *T. Anderson*, 1341, alt. 5500 feet, *Treutler*, 381.

**8.** Assam, *Griffith*, 1457. 1481, *Jenkins*, 207, 567; R. Megna, *J. D. Hooker*, 180.

**10.** Pegu, *MacClelland*. R. Irrawaddi, *Wallich*, 3308 F (hb. propr.). Andamans, *Kurz*.

**11.** Malay Peninsula, *Griffith*, Kew n. 6181. Penang, *Ridley*, 1779. Perak, *Wray*, 766. Singapore, *Kunstler*, 53, *Ridley*, 34.

*Distrib.* Mediterranea. Ethiopia. Indo-China. Oceania. East U.S. Neotropica.

28. Cyperus glaber, *Linn.*; *Hook. f. Fl. Brit. Ind.* vi. 606.

**2.** Sind, *Pinwill.*

*Distrib.* Palæarctica; from S.E. Europe throughout the Orient to Samarcand, Cabul, and S. Persia.

29. Cyperus aristatus, *Rottb.*; *Hook. f. l. c.* vi. 606.

**1.** Kashmir, alt. 7500 feet, *C. B. Clarke*, 31266. Skardo, *Schlagintweit*, 663, 6314. Dras, *Stoliczka.* Chumba, *Schlagintweit*, 1626. Punjab Himalaya, *Jacquemont*, 1276. Dalhousie, alt. 5500 metr., *C. B. Clarke*, 22845. Piti, *T. Thomson.* Kedarkanta and Mussoorie, *Royle*, 26, 27. Kumaon, *Strachey & Winterbottom*, 2, *Duthie*, 4487, 6079. Gurhwal, *G. King.* Nepal, alt. 11,000 feet, *Duthie*, 3457.

**3.** Poona, *Jacquemont*, 315.

**4.** Ceylon, very abundant, *Thwaites*, 966.

**5.** Coromandelia, *Bélanger*, 215. Madras Peninsula, *Wight*, 1819, 1820, *Wallich*, 3374, 3375 A, B. Cannanore, *Campbell.* Central India, *G. King.* Chota Nagpore, alt. 1000 feet, *C. B. Clarke*, 24791.

**6.** Moradabad, *T. Thomson*, 312. Monghir, *Wallich*, 3376 A part.

**7.** Sikkim, alt. 8000 feet, *J. D. Hooker*; Lachoong, alt. 9000 feet, *J. D. Hooker*,

*Distrib.* Ethiopia. Australia. Nearctica. Neotropica.

30. Cyperus Iria, *Linn.*; *Hook. f. l. c.* vi. 606.

**1.** Kashmir, *Jacquemont*, 873; Kishtwar, *Schlagintweit*, 2994; Rawul Pindee, *Aitchison*, 129. North-west India, *Royle*, 3, 4, 13, 17, 21. Kumaon, alt. 4000 feet, *Strachey & Winterbottom*, 10. Gurhwal, 5500 feet, *Duthie*, 4480. Mussooree, *T. Thomson*, 279. Nepal, *Wallich*, 3360 G (hb. propr.).

**2.** Punjab, *T. Thomson.*

**3.** Poona, *Jacquemont*, 344. Concan, *Law.* Malabar, *Bélanger*, 227. Nilgiri Mts., alt. 2000 feet, *Gamble*, 17982. Mangalore, *Hohenacker*, 188.

**4.** Ceylon, very abundant, *Thwaites*, 811 (hb. Mus. Brit.).

**5.** Madras Peninsula, *Rottler*, *Wight*, 1841, *Wallich*, 3360 A, B, C, D, 3361 (hb. propr.). Mysore, *Heyne*. Quilon, *Wight*, 2869. Saugor, *Vicary*. Chunda, *Duthie*, 9831.

**6.** Moradabad, *T. Thomson*, 279. Lower Bengal, *Wallich*, 3360 F, I, K; abundant, *C. B. Clarke*.

**7.** Sikkim, *J. D. Hooker*; Sonada, alt. 7000 feet, *Kurz*.

**8.** Assam, *Masters*, 200, 570. R. Megna, *J. D. Hooker*, 176. Silhet, *Wallich*, 3360 E. Garo Hills, alt. 1750 feet, *C. B. Clarke*, 43056. Khasi Hills, *J. D. Hooker*.

**9.** Yunan, *J. Anderson*.

**10.** Pegu, *Kurz*, 675, 2677. Burma, *Wallich*, 3360 H. Moulmein, *Helfer*, 253. Mergui, *Griffith*, Kew n. 6178. Andamans and Nicobars, *Kurz*.

**11.** Penang, *Curtis*, 1952. Malacca, *Griffith*, Kew n. 6178. Singapore, *Kurz*, 3003, *Ridley*, 37.

*Distrib.* Mediterranea. Indo-China. Australia.

CYPERUS IRIA, *Linn.*:

Var. *β*. PANICIFORMIS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 607.

**1.** Jamu, *Schlagintweit*, 3060.

**3.** Bombay, *Cooke*.

**4.** Ceylon, *Walker*, *Thwaites*, 811 part.

**5.** Madras Peninsula, *Wight*, 1840 (hb. propr.).

**6.** Moradabad, *T. Thomson*, 280.

**10.** South Andaman, *Kurz*.

*Distrib.* China. Japan. Malaya. Polynesia.

31. CYPERUS GLOMERATUS, *Linn.*; *Hook. f. l. c.* vi. 607.

**1.** Kashmir: Sonamurg, alt. 7000 feet, *T. Thomson*.

*Distrib.* Palæarctica. China. Japan.

32. CYPERUS DISTANS, *Linn. f.*; *Hook. f. l. c.* vi. 607.

**1.** Kumaon, *Strachey & Winterbottom*, 12; alt. 2700 feet, *Duthie*, 3458, 6083. Mussoorie, *G. King*. North-west India, *Royle*, 15, 16, 20, 21. Dehra Dhoon, *Duthie*, 2320.

**3.** Nilgiri Mts., *G. Thomson*.

**4.** Ceylon, very abundant, *Thwaites*, 810, 3844 (in Mus. Brit.).

**5.** Madras Peninsula, *Wallich*, 3366 A, B, C, D, *Wight*, 1843, 22 (in hb. Berlin); Mysore and Carnatic, *G. Thomson*.

**6.** Hindoosthan, *T. Thomson*, 1419. Monghyr, *Wallich*, 3366 E. Bengal, frequent, *C. B. Clarke*. Dacca, *J. D. Hooker*.

**7.** Sikkim, *J. D. Hooker*.

**8.** East Bengal, *Griffith*, Kew n. 6156. Upper Assam, *Jenkins*, 205, 566, *Griffith*, 1469. Cachar, *C. B. Clarke*. Khasia. *Hook. f. & T. Thoms.*

**9.** Bhamo and Hotha, *J. Anderson*.

**10.** Pegu, *Kurz*, 651, 652. Arracan, *Kurz*. Moulmein, *Helfer*, 584, *Parish*, 268. Rangoon, *Wallich*, 3366 C. Attran, *Wallich*, 3350. Mergui, *Griffith*, 151. Andamans, *Kurz*.

**11.** Penang, *Wallich*, 3366 F, *Curtis*, 1832. Malacca, *Griffith*, Kew n. 6197. Perak, *Wray*. Singapore, *Kurz*, 3001, *Kunstler*, 44, *Ridley*, 35, *Jagor*, 41.

***Distrib.*** Canaries. Ethiopia. Indo-China. Oceania. Neotropica.

33. CYPERUS NUTANS, *Vahl*; *Hook. f. Fl. Brit. Ind.* vi. 607.

**1.** Gurhwal, *G. King*, *Duthie*, 368. Kumaon, *Strachey & Winterbottom*, 8, *Duthie*, 4484. R. Sutledge (Rampore), *T. Thomson*.

**3.** Bombay, *Dalzell*. Anamallay and Pulney Mts., *Beddome*. Coorg, *Hohenacker*, 2399.

**4.** Dambool, *Thwaites*, 3844 part.

**5.** Mysore or Carnatic, *G. Thomson*. Chota Nagpore, *C. B. Clarke*, 20479, *Gamble*, 8871.

**6.** Monghyr, *Wallich*, 3347 B. Rajmahal, *Kurz*. Khoolna, *C. B. Clarke*, 33493.

**7.** Nepal, R. Tambur, *J. D. Hooker*. Sikkim Terai, *J. D. Hooker*, *C. B. Clarke*, 8899, 36760.

**8.** Assam, *Simons*. Khasia: Mahadeo, *Griffith*, Kew n. 6156; Borpani, *J. D. Hooker*, 1645. Jowye, *C. B. Clarke*, 18357. Cachar, *Keenan*.

***Distrib.*** Angola.

34. CYPERUS ELEUSINOIDES, *Kunth*; *Hook. f. l. c.* vi. 608.

**1.** Kashmir, alt. 3300 feet (Rajaori), *Schlagintweit*, 12541, Rawul Pindee, *Aitchison*, 245. Chumba, *C. B. Clarke*, 24286. R. Chenab, *T. Thomson*, 1588. Dehra Dhoon, *Jacquemont*, 410, *Royle*, 94.

**2.** Suleiman Mts., *Sanders*. Sind, *Pinwill*. Punjab, *Stewart*, 294, 384, *Aitchison*, 244. Marwar, *Duthie*, 4909, 4913.

**3.** Bombay, *Dalzell, Law.* Poona, *G. King.* Canara, *Young.* Nilgiri Mts., *G. Thomson.*

**4.** Doombera District, *Thwaites*, 3044.

**5.** Madras Peninsula, *Wight*, 2382, *Wallich*, 3346 (hb. propr.), 3347 A (hb. propr.). Coimbatore, *C. B. Clarke.* Kurnool, alt. 1000 feet, *Gamble*, 17738. Central India, *G. King*, 20. Saugor, *Vicary.* Jubbulpore, *O. Kuntze*, 7341. Chota Nagpore, *C. B. Clarke*, 20423, 21220.

**6.** Moradabad, *T. Thomson*, 399. Saharunpore, *Royle*, 14.

**7.** Darjeeling, 3300 feet, *C. B. Clarke.*

**8.** Naga Hills, *C. B. Clarke*, 41527.

*Distrib.* Mediterranea. North Trop. Africa. China. Malaya. Queensland.

35. CYPERUS THOMSONI, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 608.

**6.** North Bengal, Siligori, *C. B. Clarke*, 11688.

**8.** Assam, *Jenkins, Masters.* Seebsagur, *Kurz*, *C. B. Clarke*, 38029. Cachar, *Keenan.* Sylhet, *C. B. Clarke*, 7235, 42761 bis. Jheels, *J. D. Hooker*, 263.

*Distrib.* Tonkin.

36. CYPERUS MALACCENSIS, *Lam.*; *Hook. f. l. c.* vi. 608.

**2.** Sind, *Pinwill.*

**5.** Circars, *Roxburgh*, 196.

**6.** Bengal, in the Soondreebun very common, *Wallich*, 3329 M, N part, 3342 C part, 3351 A part, 3352 C part (said to have been collected in Nepal, but the sheet is so mixed that I attach no weight to the locality), *Griffith*, Kew n. 6206; Dacca, *C. B. Clarke*, 16958; Burisal, *C. B. Clarke*, 16935; Noakhali, *J. D. Hooker.*

**10.** Pegu, with Arracan, *Kurz.* Mergui, *Griffith*, 57, 317, Kew n. 6147.

**11.** Singapore, *Kunstler*, 106, *Hullett*, 238, 282. Pahang, *Ridley.*

*Distrib.* S. Persia. Indo-Malaya. N. Australia. Lombok.

37. CYPERUS PILOSUS, *Vahl*; *Hook. f. l. c.* vi. 609.

**1.** West Himalaya, *Royle*, 29; alt. 4000 feet, Chumba and Dhurmsala, *C. B. Clarke*, 24693. Kumaon, *Strachey & Winterbottom*, 11, *Wallich*, 3334 C, 3335 D, alt. 5000 feet, *Duthie*, 6076. Gurhwal, alt. 5000 feet, *Duthie*, 4488. Nepal, *Wallich*, 3334 B, 3355 H.

**3.** Bombay, *Burn.* Nilgiri Mts., *G. Thomson*, 4.

**4.** Central Province, very common, *Thwaites*, 797, *Macrae*, 212.

**5.** Madras Peninsula, *Wallich*, 3334 *a* part, *Wight*, 2390. Chota Nagpore, alt. 1500 feet, frequent, *C. B. Clarke.*

**6.** Purnea, *Buchanan Hamilton*, 148 ; Nathpur, *Wallich*, 3336 E part, 3355 F. Lower Bengal, *Wallich*, 3334 D, 3348.

**7.** Sikkim, *J. D. Hooker.* Bhotan, alt. 4000 feet, *Gamble*, 9599.

**8.** Assam, *Jenkins*, 197, *Masters*, 569. Suddiya, *Griffith*, 1603. Naga Hills, alt. 5000 feet, *C. B. Clarke*, 41591. Khasi Hills, alt. 4500 feet, common, *C. B. Clarke*, *Griffith*, 422, 1313, Kew n. 6162/1, *J. D. Hooker*, 1517. Sylhet, *Wallich*, 3355 E. Pundua, *J. D. Hooker*, 398. R. Soorma, *J. D. Hooker*, 324. R. Barak, *Griffith*, Kew n. 6154, 6195. Cachar, *Keenan.*

**10.** Pegu, *Kurz*, 648, 649, 2674. Arracan, *Kurz.* R. Irrawaddi, *Wallich*, 3355 I part, 190 (hb. propr.). Tavoy, *Wallich.* Mergui, *Griffith*, 181 (Kew n. 6196). Tenasserim, *Helfer*, 796 (Kew n. 6208/1). Nicobars, *Kurz*, 25977 bis.

**11.** Penang, *Curtis*, 1830, *Didrichsen*, 3491. Malacca, *Griffith*, Kew n. 6152, 6208. Singapore, *Kurz*, *Kunstler*, 111.

*Distrib.* Djur. Indo-China. Trop. Australia.

CYPERUS PILOSUS, *Vahl*:

Var. β. OBLIQUA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 610.

**3.** Nilgiri Mts., *Hohenacker*, 944 part.

**5.** Madras Peninsula, *Wallich*, 3334 *a* part.

**8.** Assam, *Griffith*, 1604. Khasia, *J. D. Hooker.*

**10.** Pegu, *Kurz*, 649 (in hb. Calcutta).

*Distrib.* Java.

CYPERUS PILOSUS, *Vahl*:

Var. γ. POLYANTHA, *C. B. Clarke in Hook. f. l. c.* vi. 610.

**6.** Bengal (Mymensingh), *C. B. Clarke*, 7763.

*Distrib.* Endemic in Mymensingh.

38. CYPERUS BABAKENSIS, *Steud. in Hook. f. l. c.* vi. 610.

**6.** Nathpur, *Wallich*, 3336 E part. Serhampore, *Lemann.* Mymensingh, *C. B. Clarke*, 7773.

**8.** East Bengal, *Griffith*, Kew n. 6207.

*Distrib.* Java.

39. CYPERUS PROCERUS, *Rottb.*; *Hook. f. Fl. Brit. Ind.* vi. 610.

**4.** Ceylon, *Burmann*, 27, *Walker*; Batticalo District, *Thwaites*, 3752, 4018, 3316 (in hb. DC.).

**5.** Madras Peninsula, *Heyne*, *Wallich*, 3355 A (hb. propr.), 3355 B (hb. Kew), 1203 (hb. Mus. Brit.), *Wight*, 1832, 2309 (hb. propr.), 38, 2871 (hb. Berlin), *Koenig*. Palicot Hills, *Rottler*. Mysore and Carnatic, *G. Thomson*, 100.

**6.** Calcutta, *Wallich*, 3342 C (hb. Mus. Brit.). Soondreebun, *C. B. Clarke*, 8460, 24711, 33471, 33487, 33492, 33607, 33626, 37068. Mymensingh, *Griffith*, Kew n. 6160, *C. B. Clarke*, 7765.

**8.** East Bengal, *Griffith*, Kew n. 6211.

**10.** Arracan, *Kurz*. Mergui, *Griffith*, 342.

**11.** Penang, *Curtis*, 1787. Kelantan, *Ridley*.

*Distrib.* China. Malaya. Queensland.

CYPERUS PROCERUS, *Rottb.*:

Var. β. LASIORRHACHIS, *C. B. Clarke in Hook. f. l. c.* vi. 610.

**4.** Ceylon, *Walker*.

**5.** Chota Nagpore, alt. 2000 feet, *C. B. Clarke*, 25079.

*Distrib.* Endemic in Ceylon and Chota Nagpore.

40. CYPERUS BULBOSUS, *Vahl*; *Hook. f. l. c.* vi. 611.

**2.** Baloochistan, *Frere*. Sind, *Dalzell*. Kurrachee, *Stocks*.

**4.** Ceylon, *Trimen*.

**5.** Mysore and Carnatic, *G. Thomson*, 102. Trichinopoly, *G. King*. Madras Peninsula, *Wight*, 1824, 1825, 1828, 29 B (in hb. Berlin), *Rottler*, *Wallich*, 3317 A part, B, C (in hb. propr.).

**6.** Aligurh, *Duthie*, 7670.

*Distrib.* Mediterranea. Ethiopia. Trop. Australia.

41. CYPERUS ARTICULATUS, *Linn.*; *Hook. f. l. c.* vi. 611.

**4.** Ceylon, *Rottler*, 171, *Ward*, 74, *Thwaites*, 3561.

**5.** Madras Peninsula, *Wallich*, 3364, *Wight*, 1823. R. Kistna, *Gamble*, 12398. Bellary, *Gamble*, 17774.

**6.** Bengal, *Griffith*, Kew n. 6214. Calcutta, *Roxburgh*. Lower Bengal, common, *C. B. Clarke*, 8204, 33345, 33460.

*Distrib.* Mediterranea. Ethiopia. Siam. Australia. East U.S. Neotropica.

42. CYPERUS TEGETIFORMIS, *Roxb.*; *Hook. f. Fl. Brit. Ind.* vi. 612.

**5.** Madras, *Wallich*, 3351 B. Bundelkund, *Duthie*, 6487.
**6.** Bengal, *Wallich*, 3351 A part (hb. propr.). Calcutta, *Kurz* (hb. *Hance*, 6193 part). Mymensingh, *C. B. Clarke*, 17308. South Bengal, *J. D. Hooker*, 12, *C. B. Clarke*, 8194, 8203, 20036.
**8.** Assam, *Jenkins*, *Griffith*, 1460, Kew n. 6204; Kamroop, alt. 500 feet, *C. B. Clarke*, 38079. Chittagong, *Hook. f. & T. Thoms.*, 40.
**10.** Moulmein, *O. Kuntze.*
*Distrib.* China. Japan.

43. CYPERUS CORYMBOSUS, *Rottb.*; *Hook. f. l. c.* vi. 612.

**1.** Kumaon, *Wallich*, 3351 E (hb. propr., Calcutta). Nepal, *Wallich*, 3525 E part (hb. propr.).
**4.** Kornegalle, *Thwaites*, 809.
**5.** Madras Peninsula, *Rottler*. Dindygul, *Koenig*. Chota Nagpore, Hazaribagh, alt. 2000 feet, *C. B. Clarke*, 33820.
**6.** Behar, *Buchanan Hamilton*, 158. Bengal, *Wallich*, 3351 D, H (hb. propr.), *C. B. Clarke*, 8523, 33128.
**8.** Assam, *Griffith*, 1459. Sylhet, *Wallich*, 3351 F (hb. propr.), *C. B. Clarke*, 17951. Pundua, *J. D. Hooker*, 356.
**10.** Pegu, *Kurz*, 668, 669, 2683. Arracan, *Kurz*, 667. Burma, *Wallich*, 3351 G (hb. propr.).
*Distrib.* Ethiopia. Neotropica.

CYPERUS CORYMBOSUS, *Rottb.*:
Var. $\beta$. PANGOREI, *C. B. Clarke in Hook. f. l. c.* vi. 612.
**5.** Madras Peninsula, *Wallich*, 3351 C (hb. Kew). Tinnevelli, *Bidie*.
*Distrib.* Nossibé.

44. CYPERUS SCARIOSUS, *R. Br.*; *Hook. f. l. c.* vi. 612.

**6.** Bengal, Soondreebun, *C. B. Clarke*, 8465, 33453, 33466, 33485.
**10.** Pegu, *Kurz*, 683, 684 (in hb. Calcutta).
*Distrib.* North and East Australia.

45. CYPERUS MACER, *C. B. Clarke*; *Hook. f. Fl. Brit. Ind.* vi. 613.
  **5.** Central India: Chunda (near Karjeli), *Duthie*, 9837.
  **8.** Chittagong: R. Kornophullee (on the rapids), *C. B. Clarke*, 19779.
  **10.** R. Khaboung (on the river-banks), *Kurz*, 671 (hb. Kew, Calcutta).
  *Distrib.* Endemic in India.

46. CYPERUS TEGETUM, *Hook. f. l. c.* vi. 613.
  **1.** Chumba, alt. 3000 feet, *C. B. Clarke*, 23688. Kangra, alt. 6300 feet, *C. B. Clarke*, 23800. Kumaon, *Wallich*, 3352 D (hb. propr.), alt. 5000 feet, *Duthie*, 4483. Almora, alt. 4000 feet (cultivated), *Madden* (for mats), *Strachey & Winterbottom*, 9. Nepal, *Wallich*, 3352 C part (hb. propr.), 1013, 3330 (hb. Mus. Brit.).
  **2.** Sind, *Pinwill*.
  **3.** Bombay, *Cooke*. Concan, *Law*.
  **4.** Ceylon, *Koenig*; not uncommon, *Thwaites*, 813.
  **5.** Madras Peninsula, *Wallich*, 3330 part (hb. propr.), 3352 A, B (hb. propr.), *Wight*, 1844. Vellore, *Rottler*. Carnatic or Mysore, *G. Thomson*, 107. Cuddapah, alt. 1000 feet, *Gamble*, 10800. Chingleput, *Gamble*, 17184. Central India: Chunda, *Duthie*, 9836. Jubbulpore, *O. Kuntze*. Chota Nagpore, *Wood*, 161, *Gamble*, 9103; alt. 700–2800 feet, common, *C. B. Clarke*, 21184, 24763, 34198.
  **6.** Behar, *R. Stone*, *J. D. Hooker*, 421. Bengal, *Roxburgh*, *Wallich*, 3332 A (hb. propr., "C. tegetum, *Roxb.*"), *Griffith*.
  **7.** Sikkim Terai, alt. 500–1000 feet, *J. D. Hooker*, *C. B. Clarke*, 10127, 36901.
  **8.** Garo Hills, alt. 1000 feet, *C. B. Clarke*, 42983. Khasia: Pundua, *J. D. Hooker*; alt. 5000 feet, *Hook. f. & T. Thoms.*; alt. 3000 feet, Borpani, *C. B. Clarke*, 16468.
  **9.** Muneypoor, alt. 3500 feet, *C. B. Clarke*, 41974.
  **10.** Karen Hills, *Kurz*, 673 (hb. Calcutta).
  *Distrib.* Endemic in India.

CYPERUS TEGETUM, *Roxb.*:
  Var. β. AMBIGUA, *C. B. Clarke in Hook. f. l. c.* vi. p. 613.
  **5.** Madras Peninsula, *Wallich*, 3330 part (hb. propr., hb. Calcutta), 3329 F (hb. Kew, not of hb. propr.).
  *Distrib.* Endemic in Madras.

47. CYPERUS ZOLLINGERI, *Steud.*; *Hook. f. Fl. Brit. Ind.* vi. 613.

**3.** Anamallay Mts., alt. 5500 feet, *Beddome.*

**4.** Ceylon, *Thwaites*, 807.

**5.** Peninsula of East India, *Wichura*, 2871.

**7.** Nepal, *Wallich*, 3321, 3367. Darjeeling, *C. B. Clarke.* Bhotan, *C. B. Clarke.*

**8.** Assam, *Jenkins*, 696. Suddiya, *Griffith.* East Bengal, *Griffith*, 1601, Kew n. 6210. Khasia, alt. 4000 feet, plentiful, *C. B. Clarke.* Naga Hills, *C. B. Clarke.* Cachar and Comilla, *C. B. Clarke.* Pundua, *J. D. Hooker*, 360. Chittagong Hills, *Wood.*

**9.** Muneypoor, *C. B. Clarke.*

**10** Andamans, *Kurz.*

**11.** Penang, *Delessert, Curtis*, 1833. Malacca, *Griffith*, Kew n. 6209. Singapore, *Kurz, Hallett, Harland.*

*Distrib.* Trop. Africa. China. Malaya. Queensland. Bouru.

48. CYPERUS LONGUS, *Linn.*; *Hook. f. l. c.* vi. 614.

**2.** Quetta, *Hamilton* (hb. Calcutta). Mt. Aboo, *G. King* (hb. Calcutta).

*Distrib.* Palæarctica. [Var. β *tenuiflora* also in Ethiopia.]

49. CYPERUS STENOSTACHYUS, *Benth.*:

Var. β INDICA, *C. B. Clarke in Hook. f. l. c.* vi. 614.

**5.** Madras Peninsula, *Wallich*, 3329 F (hb. propr. from hb. *Heyne*), 3349 (hb. propr.). "India Orient" (hb. *Forster*). "E. Ind. N." (hb. *Hooker*).

*Distrib.* Endemic in Madras. [*C. stenostachyus*, Benth., type is an Australian plant, also seen from Java.]

0. CYPERUS ROTUNDUS, *Linn.*; *Hook. f. l. c.* vi. 614.

**1.** Kurrum Valley, *Aitchison*, 684. Gilgit, *Winterbottom*, 928; alt. 5500 feet, *Giles*, 246. Rawul Pindee, *Aitchison*, 109, 128. Kashmir, *Jacquemont*, 663. Sreenuggur, alt. 5000 feet, *Schlagintweit*, 4226, 4475. Kishtwar, *Schlagintweit*, 5114, *C. B. Clarke*, 31354. Simla, *Jacquemont*, 2372. Gurhwal, *G. King.* Kumaon, *Wallich*, 3322 E. Almora, *Strachey & Winterbottom*, 7. Nepal, *Wallich*, 3322 D.

**2.** Lahore, *Brandis*, 2615. R. Sutledge, *Jacquemont*, 1102. Jullundur, *C. B. Clarke*, 23423. Sind, *Stocks*, 668. Mt. Aboo, *G. King.*

**3.** Poona, *Jacquemont*, 340, 382. Canara, *Hohenacker*. Nilgiri Mts., *G. Thomson*, *Foulkes*, *Perrottet*, 292.

**4.** Ceylon; a troublesome weed, *Thwaites*, 804.

**5.** Madras Peninsula, *Wight*, 32, 32 B, 1826, 1826 *a*, 1827, 1828, 2868; *Wallich*, 3317 A part, 3329 C, E, G, H, 3332 C, 3353 B, 3356. Mysore and Carnatic, *G. Thomson*, 102. Tranquebar, *Rottler*. Pondicherry, *Perrottet*. Madras, *Griffith*, 86, 87. Kurnool, *Gamble*, 10886. Chingleput, *Gamble*, 12197, 17183. R. Kistna, *Gamble*, 12658. Central India, *G. King*.

**6.** Moradabad, *T. Thomson*, 246. Patna, *Wallich*, 3329 D, 3353 A. Monghyr, *Wallich*, 3373 part. Bengal, *Wallich*, 3322 A, C; everywhere a weed, *C. B. Clarke*. Burisal, *J. D. Hooker*, 652.

**8.** East Bengal, *Griffith*, Kew n. 6193. Khasia, *Griffith*, 142. Upper Assam, *Jenkins*, 203.

**9.** Burma, *Wallich*, 3329 I. Amarapoora, *Buchanan Hamilton*.

**10.** Pegu, *Kurz*, 682. Moulmein, *Parish*, 264. Mergui, *Griffith*, Kew n. 6194, *Helfer*, Kew n. 6194. Andamans, *Kurz*.

**11.** Penang, *Curtis*, 1981. Singapore, *Kurz*, 3007, *Kunstler*, 112, *Ridley*, 74.

*Distrib.* Palæarctica. Ethiopia. Indo-China. Oceana. U.S. Neotropica.

CYPERUS ROTUNDUS, *Linn.*:

Var. *β.* 100-FLORA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 615.

**5.** Madras Peninsula, *G. Thomson*, 258.

**6.** Monghyr, *Wallich*, 3373 part (hb. propr.).

*Distrib.* Natal and Delagoa Bay.

51. CYPERUS STOLONIFERUS, *Retz.*; *Hook. f. l. c.* vi. 615.

**2.** Sind, *Pinwill*.

**3.** Gujerat, ——. Bombay, *Jacquemont*, 430. Nilgiri Mts., *Foulkes*.

**4.** Ceylon, *Trimen*.

**5.** Madras Peninsula, *Shuter*, *Wight*, 1819, 1824, 31 (in hb. Berlin), 1825 part, 1825 B, *Wallich*, 3315 A, B, C (hb. propr.), 3309 part. Tranquebar, *Klein*. Carnatic, *G. Thomson*. Chingleput, *Gamble*, 17195.

**10.** Ins. Nicobar, ——.

**11.** Penang, *G. King.* Pahang, *Ridley*, 1000. Singapore, *Kurz*, 2991, *Ridley*, 1749.

*Distrib.* Mauritius. China. Malaya. North Australia. Macassar.

52. CYPERUS FENZELIANUS, *Steud.*; *Hook. f. Fl. Brit. Ind.* vi. 615.

**5.** Madras, Chingapuna, *G. Thomson*, 383.

*Distrib.* Mediterranea. Trop. Africa.

53. CYPERUS SUBCAPITATUS, *C. B. Clarke in Hook. f. l. c.* vi. 615.

**3.** Nilgiri Mts., alt. 2000 feet, *Gamble*, 17952.

**5.** Madras Peninsula, *Wallich*, 3316, ex herb. Wight (in hb. propr., Kew).

*Distrib.* Endemic in Indian Peninsula.

54. CYPERUS TUBEROSUS, *Rottb.*; *Hook. f. l. c.* vi. 616.

**3.** Concan, *Law.*

**4.** Central Province, *Thwaites*, 3750, 3966.

**5.** Madras Peninsula, *Shuter*, *Wight*, 1828, 1829, 1830, 32 (in herb. Berlin), *Wallich*, 3329 B part (hb. propr.). Chingleput, *Gamble*, 17628. Tranquebar, *Wight*, 1825. Circars (?), *Wallich*, 3329 A (hb. propr.).

**6.** Calcutta and 24 Pergunnahs, *C. B. Clarke*, 8489, 8515, 33630, *Wallich*, 3329 L (hb. propr.).

**8.** East Bengal, *Griffith*, Kew n. 6141.

*Distrib.* Ethiopia. China. Australia.

55. CYPERUS ESCULENTUS, *Linn.*; *Hook. f. l. c.* vi. 616.

**1.** Dehra Dhoon, *Duthie*, 2460.

**2.** R. Chenab, *T. Thomson.*

**3.** Poona, *Jacquemont*, 277. Nilgiri Mts., *Hohenacker*, 1294.

**5.** Madras Peninsula, *Wallich*, 3354 (hb. propr.). Mysore and Carnatic, *G. Thomson*, 69. Cuddapore, alt. 4600 feet, *Gamble*, 15123.

**6.** Moradabad, *T. Thomson*, 348. Delhi, *C. B. Clarke*, 23361.

*Distrib.* Mediterranea. Ethiopia. Nearctica. Neotropica.

56. CYPERUS RADIATUS, *Vahl*; *Hook. f. l. c.* vi. 617.

**6.** Agra, *hb. Munro.* North Bengal, Siligori, *C. B. Clarke*, 26478. Dacca, *J. D. Hooker*, 130, 208, *C. B. Clarke*, 17124. Khoolna, *C. B. Clarke*, 33459.

**8.** Assam, *Griffith*, 1606, *Jenkins*, 194. Gowhatty, *Nuttall.* East Bengal, *Griffith*, 1607, Kew n. 6148, 6218/1. Silhet, *Wallich*, 3345, *C. B. Clarke*, 6938. Chittagong; Seetakoondo, alt. 800 feet, *J. D. Hooker*, 400, 409 part.

**10.** Pegu, *Kurz*, 650.

**11.** Penang, *Curtis*, 1956.

*Distrib.* Ethiopia. China. Malaya. Polynesia. Neotropica.

57. CYPERUS EXALTATUS, *Retz.*; *Hook. f. Fl. Brit. Ind.* vi. 617.

**2.** Beas Doab, *T. Thomson.* Mt. Aboo, *Stocks*, 223.

**3.** Bombay, *Dalzell.* Canara, *Law*, *Metz*, 663. Nilgiri Mts., *Foulkes.* Travancore, *Wight*, 2863.

**4.** Ceylon, *Koenig*, *Wallich*, 3343 G (hb. propr.); alt. 1400 feet, *Thwaites*, 3040, *Ploem*, 474. Trincomalee, *Thwaites*, 3788. Dambool, *Beckett.*

**5.** Coromandelia, *Bélanger*, 222. Madras Peninsula, *Rottler*, *Wight*, 1834, 1835, 2863 (hb. Berlin), *Wallich*, 3327 A, B (hb. propr.), 3329 B part (hb. propr.), 3343 A, B, C, D, E, F, H (hb. propr.). Madras, *G. Thomson*, 104. Courtallum, *G. Thomson*, 134, 135. Mysore, *Law.* Saugor, *Vicary.* Chota Nagpore, alt. 1000 feet, *C. B. Clarke*, 21090, 33801.

**6.** Moradabad, *T. Thomson*, 369. R. Goomtee, *Duthie*, 4478. Bengal, *Griffith*, Kew n. 6153, *Wallich*, 3327 C (hb. propr.), 3328 A, B (hb. propr.), 3343 I, K (hb. propr.). Calcutta (*C. B. Clarke*), 12532, 33623.

**8.** Assam, *Griffith*, 1607, *Jenkins.* Khasia, *Hook. f. & T. Thoms.*

*Distrib.* Ethiopia. Indo-China. Australia. Neotropica.

CYPERUS EXALTATUS, *Retz.*:

Var. β. DIVES, *C. B. Clarke in Hook. f. l. c.* vi. 617.

**2.** Sind, *Pinwill.* Marwar, *Duthie*, 4910.

**5.** Chota Nagpore, alt. 1200 feet, *C. B. Clarke*, 21090.

**6.** Calcutta, *Helfer*, 61. Mutlah, *C. B. Clarke*, 24707, 24713.

**8.** Chittagong, Seetakoondo, alt. 800 feet, *J. D. Hooker*, 409 part.

*Distrib.* Mediterranea. Ethiopia.

58. CYPERUS OATESII, *C. B. Clarke in Hook. f. l. c.* vi. 618.

**10.** Thyat Myo, *Oates* (in hb. Calcutta, Kew).

*Distrib.* Endemic in Pegu.

59. CYPERUS DIGITATUS, *Roxb.*; *Hook. f. Fl. Brit. Ind.* vi. 618.

**1.** Dehra Dhoon, *Royle*, 12, 17.

**2.** Sind, *Pinwill.* Lahore and R. Beas, *T. Thomson.*

**3.** Poona, *Woodrow*, 204. Londa, *Cooke*, 198. Nilgiri Mts., *Hohenacker*, 944, *G. King*, 1318.

**4.** Ceylon, *Thwaites*, 3940.

**5.** Madras Peninsula, *Heyne*, *Wight*, 1839 (25, 48 in herb. Berlin). Kurnool, *Gamble*, 17739.

**6.** Moradabad, *T. Thomson*, 255. Bengal; Rajapore, *Kurz.* Dacca and Mymensingh, *C. B. Clarke*, 7417, 7799.

**7.** Sikkim Terai, *G. King.*

**8.** Upper Assam, *Jenkins*, 202. East Bengal, *Griffith*, Kew n. 6149. R. Megna, *J. D. Hooker*, 214.

**10.** Pegu, *Kurz*, 647, 672, 2672. Burma, *Griffith*, Kew n. 6149. Mergui, *Griffith*, 1046. R. Irrawaddi, *Wallich*, 3438 D, E (hb. propr.). R. Attran, *Wallich*, 3438 E (hb. Kew).

**11.** Penang, *Wallich*, 3429, 3438 C (hb. propr.). Malacca, *Yvan.*

*Distrib.* Ethiopia. China. Malaya. Oceania. Neotropica.

CYPERUS DIGITATUS, *Roxb.*:

Var. *β*. HOOKERI, *C. B. Clarke in Hook. f. l. c.* vi. 618.

**3.** Nilgherry Mts., *Schmidt*; alt. 5750 feet, *C. B. Clarke*, 11363.

**4.** Caltura, *Moon.* Rambodda, *Thwaites*, 3043.

**5.** Chota Nagpore: Sirgooja, alt. 2750 feet, *C. B. Clarke*, 34044.

**8.** Khasia: Nunklow, *J. D. Hooker*, 1565. Moflong, *Griffith*, Kew n. 6151; frequent alt. 3–5000 feet, *C. B. Clarke.* Naga Hills, alt. 3000–6000 feet, *C. B. Clarke*, 41030, 41981.

*Distrib.* Endemic in East India.

60. CYPERUS ELATUS, *Linn.*; *Hook. f. l. c.* vi. 618.

**5.** Madras Peninsula, *Koenig*, *Rottler*, *Wight*, 1837.

**11.** Penang, *Wallich*, 3341 A (hb. propr.).

*Distrib.* Malaya. Polynesia.

CYPERUS ELATUS, *Linn.*:

Var. ? *β*. MACRONUX, *C. B. Clarke*; *Hook. f. l. c.* vi. 618.

**8.** Comilla, *C. B. Clarke*, 14188.

*Distrib.* Endemic in Assam.

61. CYPERUS PLATYPHYLLUS, *Rœm. et Sch.*; *Hook. f. Fl. Brit. Ind.* vi. 618.
   **4.** Ceylon, *Walker*, 32, *Thwaites*, 3041.
   **5.** Madras Peninsula, *Koenig*, *Rottler*, *Roxburgh*, *Wight*, 2870 (27 in herb. Berlin), *Wallich*, 3341 B part (herb. propr.).
   *Distrib.* Endemic in Madras and Ceylon.

1. MARISCUS DREGEANUS, *Kunth*; *Hook. f. l. c.* vi. 620.
   **3.** Goodaloor, alt. 3000 feet, *Gamble*, 12011.
   **4.** Central Province, up to 4000 feet, *Thwaites*, 855, 2942.
   **5.** Madras Peninsula, *Rottler*, *Leschenault*, *Roxburgh*, *Wallich*, 3326 A, B (hb. propr.), *Wight*, 1838; Pondicherry, *Perrottett*; Mysore, *G. Thomson*; Kullar, 2000 feet, *Gamble*, 16990; Pulney Hills, *Beddome*.
   **6.** Lower Bengal, *Wallich*, 3326 C (hb. propr.), 3026 (hb. Mus. Brit.).
   **10.** South Burma, *Kurz*.
   **11.** Wellesley, *G. King*. Ins. Bouton, *Delessert*. Penang, *Kunstler*, 1724. Malacca, *Griffith*, Kew n. 6172, *Cuming*, 2372. Singapore, *Delessert*, *G. Thomson*, *Burbidge*.
   *Distrib.* Ethiopia. Borneo.

2. MARISCUS BULBOSUS, *C. B. Clarke in Hook. f. l. c.* vi. 620.
   **4.** North Canara, *Young*.
   **5.** Madras Peninsula, *Heyne*, *Rottler*, *Koenig*, *Wallich*, 3441 *a* part (hb. propr.); from Palavarum to Permacoil, in the hills, *Wight*, 1846 part, *Wallich*, 3435 C, most part (hb. propr.).
   *Distrib.* Endemic in Malabar and Coromandel.

3. MARISCUS PANICEUS, *Vahl*; *Hook. f. l. c.* vi. 620.
   **3.** Mangalore, *Metz*, 150. Nilgiri Mts., *G. Thomson*.
   **4.** Ceylon, *Moon*, *Walker*, *Thwaites*, 2878.
   **5.** Coromandelia, *Bélanger*, 237. Tranquebar, *Rottler*. Madras Peninsula, *Koenig*, *Wight*, 1845, 46 (hb. Berlin), *Wallich*, 3433 (hb. propr.), 3435 A *a* (hb. propr. and Kew part), 3435 C part (hb. propr.).
   **6.** Lower Bengal, *Wallich*, 3437 B part (hb. propr.). Dacca, *C. B. Clarke*, 4616.
   *Distrib.* Mauritius.

Mariscus paniceus, *Vahl*:

Var. β. Roxburghiana, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 621.

**1.** Simla, *T. Thomson.* Nepal, *Wallich*, 3437 A (hb. Kew), 3435 *a* (hb. Berlin).

**3.** Concan, *Law.* Anamallay Mts., alt. 2750 feet, *Beddome.*

**4.** Ceylon, *Walker*, *Gardner*, 953 part, *Thwaites*, 814.

**5.** Madras Peninsula, *Wight*, 1845 part, 1847 (hb. Berlin), *Wallich*, 3434, 3435 B (hb. propr.). Pondicherry, *Perrottet.*

**6.** Dacca, *C. B. Clarke*, 20081.

**7.** Sikkim Terai, alt. 500 feet, *C. B. Clarke*, 36806.

**8.** East Bengal, *Griffith*, Kew n. 6242 part.

*Distrib.* Java. Cochinchina.

4. Mariscus cyperinus, *Vahl*; *Hook. f. l. c.* vi. 621.

**1.** [Simla], *Lady Dalhousie.*

**3.** Nilgiri Mts., *Perrottet.*

**4.** Ceylon, *Walker*, *Thwaites*, 816.

**5.** Coromandelia, *Roxburgh.* Madras Peninsula, *Rottler*, *Wight*, 47 C (hb. Berlin), *Wallich*, 3431, 3435 *a* part, 3436 (hb. propr.). Mysore, *Heyne.*

**6.** Moradabad, *T. Thomson.*

**10.** Tenasserim (or Andamans), *Helfer*, Kew n. 6244.

**11.** Penang, *Delessert.* Malacca, *Griffith*, Kew n. 6243 part. Pahang, *Ridley*, 1270. Sitang, *Gaudichaud*, 14. Singapore, *Walker*, 243, *Didrichsen*, 4419, *O. Kuntze*, 6083.

*Distrib.* China. Japan. Malaya. Polynesia.

Mariscus cyperinus, *Vahl*:

Var. bengalensis, *C. B. Clarke in Hook. f. l. c.* vi. 621.

**6.** North Bengal, *Wallich*, 3437 F (hb. propr.). Dacca, *J. D. Hooker*, 99, 129.

**7.** Sikkim, *J. D. Hooker*, *T. Anderson*, alt. 0–5000 feet, *C. B. Clarke*, 26595, 35403.

**8.** East Bengal, *Griffith*, 1483, Kew n. 6244 part. Upper Assam, *Jenkins*, 568. Khasia, Cherra, *J. D. Hooker*, 677. Sylhet, *C. B. Clarke*, 8402.

*Distrib.* Endemic in Bengal and Assam.

MARISCUS CYPERINUS, *Vahl*:

Var. MAXIMA, var. nova: very large; bracts of umbel 10 or 12, long; rays of umbel 16, up to 4 in. long; spikes 1 by $\frac{2}{5}$ in.; spikelets very numerous, densely packed, in fruit sloping somewhat upwards.

[**5.**] East India, *Roxburgh* (hb. Delessert).

*Distrib.* Sumatra.

**5.** MARISCUS PICTUS, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 621.

**3.** Nilgiri Mts., *G. Thomson.* Mysore, *Heyne, G. Thomson.*

**5.** Madras Peninsula, *Wight*, 1846 [Nees' "type"], *Wallich*, 3435 *a* part. (hb. propr.), 3437 (hb. Mus. Brit.) Carnatic, *G. Thomson.*

*Distrib.* Java. Polynesia.

**6.** MARISCUS TENUIFOLIUS, *Nees*; *Hook. f. l. c.* vi. 622 [Schrader MS. *fide* Nees].

**4.** Ceylon, *Koenig*, *Gardner*, 953 part., *Thwaites*, 817.

**5.** Madras Peninsula, *Heyne*, *Wight*, 1846 part. (hb. Kew), *Wallich*, 3432 *a* (hb. propr.), 3435 *c* (hb. Mus. Brit.). Tinnevelly Hills, *Beddome.*

**6.** Monghir, *Wallich*, 3432 B (hb. propr., Kew).

**11.** Malacca, *Griffith*, Kew n. 6241.

*Distrib.* Endemic in India.

In ticketing herbarium specimens, and in casual references, it is usual to call this plant (by 3 words) *Mariscus tenuifolius*, Schrader. If this is stated thus it sends one to the wrong book; if it is stated Schrader MS. it is rather worse than (2 words) *Mariscus tenuifolius*; for it gives no help to finding the published description, and besides that may mislead one into assuming the plant unpublished.

The ground for calling it *Mariscus tenuifolius*, Schrader, is that it is only justice to Schrader. In the present (and most similar cases) I see no sufficient proof that Schrader distinguished the plant; he may have noticed that the example was narrow-leaved. However this may have been, I agree with Darwin in his argument that all consideration of persons in this matter must be postponed to the convenience of science; and I think it is most convenient to postpone all MS. names to published names, and to make the *primary* reference to the latter.

**7.** MARISCUS SIEBERIANUS, *Nees*; *Hook. f. l. c.* vi. 622.

**1.** Gurhwal, *T. Thomson*, 272; alt. 5000 feet, *Duthie*, 367. Almora, alt. 5000 feet, *Strachey.* Nipal, *Wallich*, 3437 *a* (hb. propr.).

3. Anamallay Mts., *Beddome.*
5. Mysore, *Heyne*, *Wight*, 1847 (*second* type of *M. cyperinus*, Nees), *Wight*, 1240, 47 B (hb. Berlin). Chota Nagpore, alt. 4000 feet, *C. B. Clarke*, 33685.
6. Northern India, *Royle*, 33, *Schlagintweit*, 3285; Upper Gangetic Plain, *T. Thomson.* Lower Bengal, *Wallich*, 3437 B part. (hb. propr.).
8. East Bengal, *Griffith*, Kew n. 6242. Assam, *Griffith*, 1477, *Jenkins.* Sylhet, *Wallich*, 320 (hb. Berlin). Khasia, alt. 3000 feet, *J. D. Hooker*, alt. 5000 feet, *C. B. Clarke*, 43573. Naga Hills, alt. 5000 feet, *C. B. Clarke*, 41600.
10. Pegu, *MacClelland*; Prome, *Wallich*, 3437 C (hb. propr.). Tenasserim, *Helfer*, 307, Kew n. 6243/1.
11. Penang, *Delessert*, *Curtis.* Malacca, *Griffith.* Singapore, *Lobb*, *Ridley.*

*Distrib.* Ethiopia. Indo-China. Oceania.

The above represent the Indian localities from such herbarium specimens as I noted when they passed through my hands. In this case (and in many similar cases, more or less so) the method of area-tabulation herein followed gives a very imperfect, *primâ facie* erroneous, impression of the distribution of this plant in India. I believe it to be one of the most abundant and most generally distributed plants of India, everywhere in or near hills, alt. 0–5000 feet, and only absent in dry places and long-cultivated areas.

The breakdown of the method of numerical tabulation here adopted is not wholly the fault of the method. Firstly, few botanists (who collect) trouble to collect so common a plant, which thus only reaches the great herbaria in casual collections. Secondly, in the great herbaria, any example (unless it presents some marked peculiarity) is not laid in, any more than a Daisy from Surrey. No general method of tabulating areas from herbarium specimens would give a fair quantitative (or complete areal) distribution of the Daisy.

MARISCUS SIEBERIANUS, *Nees*:

Var. *β*. EVOLUTIOR, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 622.

1. Simla, *Lady Dalhousie.* Gurhwal, alt. 6500 feet, *Schlagintweit*, 8802. Nipal, *Wallich*, 3437 A.
7. Sikkim, *J. D. Hooker*, *T. Anderson*, 264, 782.
8. Khasia, *J. D. Hooker.* Cachar, *C. B. Clarke*, 7079.
10. Mergui, *Griffith*, 87 (having the fruiting spikelets deflexed more than usual).

*Distrib.* Ethiopia. Malaya. East U.S. Central America. North Brasil.

MARISCUS SIEBERIANUS, *Nees*:

Var. γ. SUBCOMPOSITA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 622.

**1.** Kumaon, alt. 5000 feet, *Strachey*.

[**5.** Madras Peninsula ?], *Wallich*, 3437 E (hb. propr.).

*Distrib.* Japan. Malaya. Polynesia.

MARISCUS SIEBERIANUS, *Nees*:

Var. ? δ. KHASIANA, *C. B. Clarke in Hook. f. l. c.* vi. 622.

**8.** East Bengal, *Griffith*, Kew n. 6244 part.

*Distrib.* Endemic in East Bengal.

8. MARISCUS ISCHNOS, *C. B. Clarke in Hook. f. l. c.* vi. 623.

**4.** Nilgiri Mts. and Kurg, *G. Thomson*.

*Distrib.* Mexico, Western Venezuela, Colombia.

There is one sheet only of Malabar examples inscribed as above. The specimens are good, and there can be no doubt they are *M. ischnos* (Schlecht. sub *Cypero*), a plant with a very well circumscribed area, frequent in the Northern Andes Region with Mexico. I have frequently doubted whether the Malabar locality is other than a ticket wrongly posted down.

9. MARISCUS HOOKERIANUS, *C. B. Clarke in Hook. f. l. c.* vi. 623.

**7.** Sikkim, in hot valleys, *J. D. Hooker*.

*Distrib.* Endemic in Sikkim.

It must be understood that the species of *Mariscus* [1–8 foregoing] are very closely allied; probably Mr. Bentham would have called them all "*Cyperus umbellatus*." Hence, in order to keep the species 1–8 at all distinct, it is necessary to narrow down their diagnoses. When this has been done, I find that Hooker's Sikkim-hot-valley example will not go into any one of the 8. It is then necessary to make it a new species, *M. Hookerianus,* unless I attempt some new grouping for the material of the 8.

10. MARISCUS SQUARROSUS, *C. B. Clarke in Hook. f. l. c.* vi. 623.

**3.** Mangalore, *Metz*, 823.

**4.** Ceylon, *Koenig*.

**5.** Madras Peninsula, *Wight*, 1810 A, B, *Wallich*, 3313 A, B, part. Maisor and Carnatic, *G. Thomson*.

**6.** Bengal, *Masters.*

**10.** Rangoon, *Kurz.* Mergui, *Griffith*, 18, 337, Kew n. 6203.

*Distrib.* Ethiopia. Cochinchina.

11. Mariscus albescens, *Gaud.*; *Hook. f. Fl. Brit. Ind.* vi. 623.

**3.** Bombay, *Cooke.*

**4.** Ceylon, *Koenig*; hotter parts, *Thwaites*, 678.

**5.** Quilon, *Wight*, 2866, *Wallich*, 3359 A, B (hb. propr.). Madras Peninsula, *Wight*, 39 (hb. propr.), 1833.

**6.** North Bengal, *Buchanan Hamilton*, 164. Soondrebun, *C. B. Clarke*, 24717.

**10.** Moulmein, *Wallich*, 3359 E (hb. propr.). Andamans, *Kurz.*

**11.** Malay Peninsula, *Griffith*, Kew n. 6159. Penang, *Wallich*, 3359 D part. (hb. propr.), *Curtis*, 104. Malacca, *Griffith.* Singapore, *Lobb*, *Ploem*, 520.

*Distrib.* Ethiopia. China. Malaya. Oceania.

12. Mariscus microcephalus, *Presl*; *Hook. f. l. c.* vi. 624.

**1.** West Himalaya, *Royle*, 135.

**2.** Sind, *Pinwill.*

**3.** Canara, Yellapore, *Talbot*, 1024. Nilgiri Mts., *G. Thomson*, 34.

**4.** Ceylon, *Walker*, *Thwaites*, 815: Kornegalle, *Gardner.*

**5.** Madras Peninsula, *Wight*, 1848, 45 (in hb. Berlin). Cuddapa, *Beddome.* Chota Nagpore, 1–3000 feet, common, *C. B. Clarke.*

**6.** Gangetic Plain, Moradabad, *T. Thomson*, 324. Indalpur, *Duthie*, 4477. Upper Gangetic Plain, *Falconer*, 1143.

**7.** Sikkim Terai, *C. B. Clarke*, 26779, 36609, *O. Kuntze.*

**8.** Assam, *Griffith*, 1461, 1482, frequent, *C. B. Clarke.* East Bengal, *Griffith*, Kew n. 6245, 6246. Khasia, *Hook. f. et T. Thoms.*, 28. Cachar, *Keenan.* Sylhet, *C. B. Clarke*, 6960. R. Soorma, *J. D. Hooker*, 328.

**10.** Pegu, *Kurz*, 660, 661; Sittang, *R. Scott*, 397. Mergui, *Griffith*, 317, 341. Andamans, *Kurz.* Nicobars, *Kurz.*

**11.** Penang and Singapore, *Wallich*, 3439. Malacca, *Griffith.* Singapore, *Harland*, 857.

*Distrib.* Mauritius. China. Malaya.

VI. TORULINIUM, *Desv. in Hamilt. Prod. Ind. Occident.* [1825] p. 15.

Rhacheola of the several-nutted spikelets disarticulating into 1-nutted joints; otherwise as *Mariscus*.

1. TORULINIUM CONFERTUM, *Hamilton, Prod. Ind. Occid.* [1825] p. 15.

[*Mariscus ferax*, C. B. Clarke; Hook. f. Fl. Brit. Ind. vi. 624.]

**6.** Lower Bengal (Furidpore), *C. B. Clarke*, 7511.

**10.** Pegu, *Kurz*, 2686. Mergui, *Griffith*, 315, Kew n. 6143, 6198.

*Distrib.* Canaries. Trop. Africa. China. Malaya. Oceania. U.S. Neotropica.

1. COURTOISIA CYPEROIDES, *Nees*; *Hook. f. l. c.* vi. 625.

**3.** Concan, *Law*; Mercara, *Hohenacker*, 645.

**5.** Madras Peninsula, *Heyne*, *Wight*, 1853. Mysore, *G. Thomson*. Russelconda Hills, *Beddome*. Chanda, *Duthie*, 9843. Goonah, *G. King*, 41. Chota Nagpore, alt. 2000 feet, *Gamble*, 8732, frequent, *C. B. Clarke*.

**7.** Sikkim, alt. 500 feet, *C. B. Clarke*, 36608.

**8.** Sudiya, *Griffith*, Kew n. 6240. Mongoldye, alt. 350 feet, *Schlagintweit*, 13489. Khasia, R. Ongkot, *J. D. Hooker*, 2346, frequent, *C. B. Clarke*. Silhet, *Wallich*, 3537.

**10.** Pegu, *Kurz*, 629, 2719.

*Distrib.* Endemic in India; a var. in South Africa and Madagascar.

1. ELEOCHARIS PLANTAGINEA, *R. Br.*; *Hook. f. l. c.* vi. 625.

**2.** Sind, *Pinwill*.

**4.** Ceylon, *Macrae*, 167. South Ceylon, *Thwaites*, 3046.

**5.** Madras Peninsula, *Rottler*, *Wallich*, 3454 A (hb. propr.), 3543 (hb. Calcutta, Berlin), *Wight*, 1891, 1901 (hb. propr.), 72, 72 B (hb. Berlin). Chota Nagpore, alt. 200 feet, *C. B. Clarke*, 33808.

**6.** Moradabad, *T. Thomson*, 351. Saharunpore, *Lemann*. Monghyr, *Buchanan Hamilton*, 209, *Wallich*, 3454 C (hb. propr.). Bengal, *Buchanan Hamilton*, 210, *Wallich*, 3454 D (hb. propr.), *C. B. Clarke*, 8520, 17246, 33606.

**8.** Assam, *Simons.* East Bengal, *Griffith*, Kew n. 6232. Pundua, *J. D. Hooker*, 359.

**10.** Pegu, *Kurz*, 2715. Arracan, Akyab, *Kurz*, 2714.

*Distrib.* Ethiopia. Indo-China. Oceania.

2. ELEOCHARIS EQUISETINA, *Presl*; *Hook. f. Fl. Brit. Ind.* vi. 626.

**4.** Ceylon, *Walker*; Kornegalle, *Thwaites*, 3777.

**11.** Penang, *Didrichsen*, 3487.

*Distrib.* Luzon. New Caledonia.

3. ELEOCHARIS VARIEGATA, *Kunth*:

Var. LAXIFLORA, *C. B. Clarke in Hook. f. l. c.* vi. 626.

**4.** Ceylon, herb. *Nees*, 1691, *Macrae*, 210, *Walker*, 45. South Ceylon and Ambagamova, *Thwaites*, 3762.

**5.** Madras Peninsula, *Rottler*, *Wallich*, 3454 B part (hb. propr.).

**8.** Gowhatty, *Simons* (hb. Calcutta). Sylhet, *J. D. Hooker.*

**10.** Tenasserim (or Andamans), *Helfer*, Kew n. 6220/1, n. 6223/1.

**11.** Malacca, *Griffith*, Kew n. 6229. Pahang, *Ridley*, 1231, 1548. Singapore, *Kurz*, 3014 (hb. Calcutta), *Ploem*, 522.

*Distrib.* China. Malaya. Polynesia. Cuba.

4. ELEOCHARIS OCHROSTACHYS, *Steud.*; *Hook. f. l. c.* vi. 626.

**11.** Malacca, *Griffith*, 2864 (hb. Berlin). Singapore, *Ridley*, 30. "Calcutta" (*forsan* Malacca), *Lemann* (hb. Boissier).

*Distrib.* Java. Borneo.

5. ELEOCHARIS FISTULOSA, *Link, Jahrb.* iii. [1820] 78; *Schultes* [1824], *Hook. f. l. c.* vi. 626.

**3.** Canara, *Talbot*, 1040.

**4.** Ceylon, *Macrae*; "hotter parts," *Thwaites*, 3047, 3162.

**5.** Madras Peninsula, *Wight*, 1902, 2881 (hb. propr.), *Wallich*, 3453 A, B, C (hb. propr.). Carnatic, *G. Thomson*, 43. Tinnevelly, alt. 2750 feet, *Beddome.* Chunda, *Duthie*, 9855. Chota Nagpore, alt. 2000 feet, *C. B. Clarke*, 20346.

**6.** Moradabad, *T. Thomson*, 388. Purneah, *Buchanan Hamilton*, 208, *Wallich*, 3453 D (hb. propr.). Jumalpore, *Griffith*, Kew n. 6235.

**7.** Nepaul, *Wallich*, 3453 A part, B (hb. Kew), E (hb. propr.). Julpigori, *C. B. Clarke*, 26769.

**8.** Assam, *Griffith*, 1589, 1600, *Jenkins*, 216, *C. B. Clarke*, 40768. Pundua, *Wallich*, 3451 (hb. Berlin), *J. D. Hooker*, 358.

**10.** Mergui, *Griffith*, 295. Tavoy, *Wallich*. Tenasserim, *Helfer*, Kew n. 6235.

**11.** Malay Peninsula, *Griffith*, Kew n. 6230.

*Distrib.* Ethiopia. China. Malaya. Oceania.

6. ELEOCHARIS SPIRALIS, *R. Br.*; *Hook. f. Fl. Brit. Ind.* vi. 627.

**3.** Bombay, Salsette Isle, *Jacquemont*, 446, 725 (hb. Paris).

**4.** Ceylon, *Walker* hb. *Wight*, 2054; hotter parts, *Thwaites*, 853.

**5.** Madras Peninsula, *Rottler*, *Wallich*, 3454 B part (hb. propr.).

**6.** Calcutta, *Kurz*.

**8.** East Bengal, *Griffith*, Kew n. 6231.

**10.** Pegu, *Kurz*, 2713. Mergui, *Griffith*.

*Distrib* Mauritius. Cochinchina.

7. ELEOCHARIS ATROPURPUREA, *Kunth*; *Hook. f. l. c.* vi. 627.

**1.** Jhelum Valley, *Stewart*, 784. Chumba, alt. 3000 feet, *C. B. Clarke*, 23777.

**2.** Sind, *Pinwill*; Shalizan, *Aitchison*, 603. Shahjehanpore, *Duthie*, 5003.

**3.** Bombay, Hewra, *Dalzell*.

**4.** Ceylon, *Moon* (hb. Mus. Brit.), *Leschenault* (hb. Paris).

**5.** Coromandelia, *Bélanger*, 196. Madras Peninsula, *Koenig*, *Rottler*, *Wight* 1899 part, *Wallich*, 3489 B (hb. propr.). Saugor, *G. King*, 46. Chunda, *Duthie*, 9847. Chota Nagpore, alt. 2000 feet, *C. B. Clarke*, 21174, 21215.

**6.** Moradabad, *T. Thomson*, 322. Furruckabad, *Buchanan Hamilton*, 206. Bengal, *Wallich*, 3489 A (hb. propr.), 3487 part (hb. Kew), *Griffith*, Kew n. 6224, *J. D. Hooker*.

**8.** Assam, *Griffith*, 1592, 1593.

*Distrib.* Europe. Ethiopia. China. Malaya. Oceania. U.S. Neotropica.

Mo. Bot. Garden,
1901.

8. Eleocharis capitata, *R. Br.*; *Hook. f. Fl. Brit. Ind.* vi. 627.

**2.** Kurrachee, *Stocks.*

**3.** Canara, *G. Thomson.*

**4.** Ceylon, *Leschenault, Walker*; Saffragam, *Thwaites*, 3039.,

**5.** Madras Peninsula, *Wallich*, 3486 A, B (hb. propr.), 3487 A (hb. propr.), 3493 (hb. propr.), *Wight*, 1899 part, 74 (hb. Berlin). Central Provinces, *Duthie*, 8462. Chota Nagpore, alt. 1000 feet, *C. B. Clarke*, 34263, 34288.

**6.** Behar, *J. D. Hooker*, 622. Bengal, *Wallich*, 3486 C (hb. propr.), *Griffith*, Kew n. 6225 (hb. Paris). Noakhali, *J. D. Hooker*, 622.

**10.** Mergui, *Griffith*, 287.

**11.** Singapore, *Ridley*, 133.

*Distrib.* Mediterranea. North Trop. Africa. China. Malaya. Oceania. U. S. Neotropica.

9. Eleocharis ovata, *R. Br.*; *Hook. f. l. c.* vi. 628.

[**1.** West Himalaya] ? *Wallich*, 3487 part (hb. Kew).

*Distrib.* Palæarctica. Japan. Java. Nearctica. Neotropica.

No example from British India has been seen, except Wallich 3487 part. The manner in which the Wallichian collections were mixed before the numbers were affixed renders the Wallichian herbarium unless supported very unsatisfactory authority for localities. The distribution, however, of *E. ovata*, R. Br., from Russia and Asia Minor, by the Caucasus and Dahuria to Amurland and Japan, renders it probable that it has been, or will be, collected in the Himalaya; and it was therefore included in the 'Flora of British India.'

10. Eleocharis palustris, *R. Br.*; *Hook. f. l. c.* vi. 628.

**1.** Kurrum Valley, *Aitchison*, 34, 235, 601. Baltisthan, alt. 12,000 feet, *C. B. Clarke*, 30405. Rawul Pindee, *Aitchison*, 558. Murree, *Fleming*, 329. Kashmir, *Jacquemont*, 444. Ladak, *Schlagintweit*, 1082, 1446. Nubra, *Schlagintweit*, 2065. West Himalaya, *Royle*, 62 (hb. propr.), 97, 100 (hb. Berlin). Chini, *Jacquemont*, 1333. Simla, *Jacquemont*, 973. Kumaon, *Wallich*, 3449 (hb. propr.), *Duthie*, 6071 *a*. Nepal, *Wallich*, 3452 (hb. Calcutta).

**2.** Sind, *Pinwill*; Punjab, *T. Thomson.*

**6.** Moradabad, *T. Thomson*, 449. Oude, *Wallich*, 3455 (hb. propr.). Lucknow, *T. Anderson.* Furruckabad, *Buchanan Hamilton*, 207. Nawabgunj, *Wallich*, 3450 (hb. propr.). Bengal Plain, frequent, *C. B. Clarke.*

**7.** Sikkim, alt. 10,000 feet, *J. D. Hooker.*

**8.** Bruhmapootra Bank, *Griffith*, Kew n. 6221. Khasi Hills, *Wallich*, 3451 (hb. propr.). Sylhet, *C. B. Clarke*, 42736.

***Distrib.*** Palæarctica. Ethiopia. China. Japan. Sandwich Isles. Nearctica. Neotropica.

11. ELEOCHARIS ACICULARIS, *R. Br.*; *Hook. f. Fl. Brit. Ind.* vi. 628.

**5.** Madras Peninsula, *Rottler* (hb. Kew).

***Distrib.*** Palæarctica. China. Japan. Nearctica. Neotropica.

The single example in herb. Rottler can hardly establish the present species as Indian. But it grows in Central Asia, is abundant in Japan, and has been frequently collected in China, even at Shanghai and Canton.

12. ELEOCHARIS CHÆTARIA, *Roem. et Sch.*; *Hook. f. l. c.* vi. 629.

**3.** Canara, *Bélanger*, 195.

**4.** Ceylon, *Macrae*, 207; Saffragam, *Thwaites*, 247.

**5.** Madras Peninsula, *Wallich*, 3415 (hb. propr.). Quilon, *Wight*, 2031, 2895. Chota Nagpore, alt. 2500 feet, *C. B. Clarke*, 25189, 34192.

**6.** Dacca, *C. B. Clarke*, 7889.

**7.** Siligori, *O. Kuntze.* Kooch Behar, in the plain, *C. B. Clarke*, 26780.

**8.** East Bengal, *Griffith*, Kew n. 6219. Sylhet and Cachar, common, *C. B. Clarke.* Chittagong, *J. D. Hooker*, 157.

**10.** Pegu, *Kurz*, 2708, *Bélanger*, 194. Rangoon Lake, *Kurz*, 2707. Burma, *Griffith*, Kew n. 6318 (hb. Berlin).

**11.** Malacca, *Griffith*, Kew n. 6319, *Gaudichaud*, 97. Pahang and Singapore, *fide* Ridley.

***Distrib.*** Trop. Africa. Malaya. Neotropica.

13. **Eleocharis subvivipara**, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 629.

**8.** Khasi Hills, alt. 5000 feet, at several places, in great quantity, *C. B. Clarke*, 19227, 45617, 45920.

*Distrib.* Central Madagascar.

Boeckeler gives, as the Indian habitat for this species, the Nilghiri Hills. I have never seen any Nilghiri examples; and, from my acquaintance with the Berlin Herbarium and Boeckeler's work thereon, I think the most probable explanation is that Boeckeler's (supposed) Nilghiri examples came from Khasia.

14. **Eleocharis afflata**, *Steud.*; *Hook. f. l. c.* vi. 629.

**8.** Assam, *Griffith*, 1581; *Jenkins*, 577. East Bengal, *Griffith*, Kew n. 6225 part. Khasia, *J. D. Hooker*, 1591, 2405; up to 5500 feet, common, *C. B. Clarke*. Cachar, frequent, *C. B. Clarke*.

**9.** Muneypoor, *Watt*, 6311. Shan States, *Collett*, 352.

**10.** Burma, *Griffith*, Kew n. 6223.

*Distrib.* China. Japan. Malaya.

15. **Eleocharis congesta**, *D. Don*; *Hook. f. l. c.* vi. 630.

**1.** Kashmir, Budrawur, alt. 6500 feet, *C. B. Clarke*, 31504. Kumaon, alt. 7500 feet, *Strachey & Winterbottom*. Dhurmsala, *C. B. Clarke*, 24694. Kedarkanta, *Royle* 57 (hb. propr.). Gurhwal, *Duthie*, 69, 5004 (with very plumose setæ). Nepal, *Wallich*.

**2.** Punjab, *T. Thomson*, 689.

**3.** Nilghiri Mts., *Perrottet*, *Schmidt*; Canoor, alt. 5500 feet, *Gamble*, 11506, 17282.

**4.** Central Province, at high levels, *Thwaites*, 2635.

**5.** Madras Peninsula, *Wight*, 2882 (herb. Calcutta, a *Fimbristylis* mixed). Chota Nagpore, alt. 1500–3000 feet, *C. B. Clarke*, 20583, 25092, 34299, 34302.

*Distrib.* Endemic in India, the western side; but the Chota Nagpore plant is hardly separate from *E. afflata*; especially its large forms in Khasia and Japan.

16. **Eleocharis tetraquetra**, *Nees*; *Hook. f. l. c.* vi. 630.

**1.** Kumaon, *Wallich*, 3449 (hb. Kew), *Royle*, 57. Kedarkanta, *Royle*. Gurhwal, *Duthie*, 5004. Nepal, *Wallich*, 3452 (hb. propr. & Kew).

**3.** Nilghiri Mts., *Perrottet*, 675, 676 (hb. Paris), 1195, 1214, 1215 (hb. Boissier); alt. 6500 feet, *C. B. Clarke*, 10926, 10945.

**4.** Central Province, Rambodde, alt. 4000 feet, *Thwaites*, 2397.

**7.** Sikkim, alt. 6500–12,000 feet, *J. D. Hooker*, 23; alt. 1750 feet, *C. B. Clarke*, 9448.

**8.** Khasia, alt. 4000–5000 feet, *J. D. Hooker*, 1552, *C. B. Clarke*, 5196, 43554, 43571.

**10.** Burma, *Kurz*, 643.

*Distrib.* China. Japan (abundant). Malaya. New South Wales.

1. FIMBRISTYLIS TETRAGONA, *R. Br.*; *Hook. f. Fl. Brit. Ind.* vi. 631.

**3.** Bombay, *Dalzell*, *Jacquemont*, 747; Carenga Island, *Boivin*, 782. Canara (and Mysore), *Law*.

**4.** Ceylon, *Walker*; common in rice, *Thwaites*, 830.

**5.** Madras Peninsula, *Wight*, 2331, 2882 (hb. Paris). Saugor, *Vicary*; Chunda, *Duthie*, 9875, 9876. Chota Nagpore, alt. 1000–2700 feet, common, *C. B. Clarke*.

**6.** North Bengal, *Kurz*. Noakhali, *C. B. Clarke*, 8197.

**7.** Nipal, *Wallich*, n. 3490 part.

**8.** Khasia, *Hook. f. & T. Thoms.*, n. 23; in the tropical region, *J. D. Hooker*, 399.

**10.** Rangoon, *Wallich*, 3490 F (hb. propr.), *Kurz*, 2693. Mergui, *Griffith*, 319, Kew n. 6296. Tavoy, *Wallich*, 232 (hb. DC.).

**11.** Pahang, fide *Ridley*.

*Distrib.* China. Malaya. Australia. Celebes.

2. FIMBRISTYLIS ACUMINATA, *Vahl*; *Hook. f. l. c.* vi. 631.

**1.** Kumaon, *Wallich*, 3494.

**4.** Ceylon, *Macrae*, 178, *Thwaites*, 2747.

**5.** [South India?], *Wight*, 2051.

**7.** Sikkim Terai, *Hook. f. & T. Thoms.*, 58 part., *Kurz*, *King*, *C. B. Clarke*, 36805, 36939.

**8.** Assam, *Jenkins*. Chittagong, *J. D. Hooker*.

**10.** Arracan, *Kurz*. Burma, *Wallich*, 3494 (hb. propr.), 3487 B 1 part (hb. propr.); Mergui, *Griffith*, 179; Rangoon, *MacClelland*. Tenasserim, *Helfer*, Kew n. 6293.

**11.** Penang, *Delessert*, *King*, *Didrichsen*, 3558. Malacca, *Griffith*, Kew n. 6295. Singapore, *Kurz*, *Ridley*, 1472.

*Distrib.* Hongkong. Malaya. Australia.

3. FIMBRISTYLIS SETACEA, *Benth.*; *Hook. f. Fl. Brit. Ind.* vi. 632.

**10.** South Burma, *Kurz.*

**11.** Singapore, *Kurz*, *Ridley*, 107.

*Distrib.* Malaya. North-east Australia.

4. FIMBRISTYLIS NUTANS, *Vahl*; *Hook. f. l. c.* vi. 632.

**4.** Ceylon, *Wight*, *Macrae*, 253, *Walker*, 41, *Thwaites*, 832, *Brandis*, 2485.

**8.** Khasia: Nya Bungalow, alt. 2700 feet, *C. B. Clarke*, 40639.

**10.** Mergui, *Griffith*, 76. Tenasserim, *Helfer*, Kew n. 6294. Nicobars, *Kurz*, *Kamphoevener*, 2482.

**11.** Singapore, *Ridley*, 1868.

*Distrib.* China. Borneo. Australia.

5. FIMBRISTYLIS POLYTRICHOIDES, *Vahl*; *Hook. f. l. c.* vi. 632.

**3.** Bombay: Kalyan, *Woodrow*, 12.

**4.** Trincomalee, *Thwaites*, 3786.

**5.** Madras Peninsula, *Klein*, *Rottler*, *Wight*, 1866, 102 (hb. Berlin).

**6.** Lower Bengal, *Wallich*, 3487 B 2, C (hb. propr.). Soondreebun, plentiful, *C. B. Clarke.*

**8.** East Bengal, *Griffith*, Kew n. 6225 part.

**10.** Burma, *Griffith*, Kew n. 6295 (hb. Paris). Mergui, *Griffith.*

**11.** Penang, *Wallich*, 3532 (hb. propr.). Malacca, *Griffith.*

*Distrib.* Malaya. North Australia.

FIMBRISTYLIS POLYTRICHOIDES, *Vahl*:

Var. HALOPHILA, *C. B. Clarke in Hook. f. l. c.* vi. 632.

**5** Nellore, *Gamble*, 12681.

**6.** Soondreebun, *Kurz.*

*Distrib.* Isle of Chusan.

6. FIMBRISTYLIS TENUICULA, *Boeck.*; *Hook. f. l. c.* vi. 632.

**8.** Sylhet, *C. B. Clarke*, 7128.

**10.** Moulmein, *Helfer*, 279 (hb. DC.). Tenasserim (or Andamans), *Helfer*, Kew n. 6223/1, n. 6226/1.

*Distrib.* Endemic in Assam and Pegu.

7. FIMBRISTYLIS PAUCIFLORA, *R. Br.*; *Hook. f. l. c.* vi. 633.

**10.** Mergui, *Griffith*, 603, Kew n. 6318.

**11.** Penang, *Curtis*, 1789. Wellesley, *G. King.* Malacca, *Maingay*, 3190. Perak, *Wray*, 772. Singapore, *Wallich*, 3488 (hb. propr.), *Kurz*, 3009, *Schottmueller*, 114, *Didrichsen*, 4431, *Ridley*, 2, 40, 122, 152.

*Distrib.* Malaya. Oceania.

8. FIMBRISTYLIS KINGII, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 633.

**3.** Nilghiris, alt. 6000–8000 feet, *King*, *Perrottet*, 681, 1209, *Schmidt*, *Gamble*, 11839, 12288; Pycara, *Beddome*, 7841.

*Distrib.* Endemic in the Nilghiris.

9. FIMBRISTYLIS SUBTRABECULATA, *C. B. Clarke in Hook. f. l. c.* vi. 633.

**3.** Nilghiris, Pykara, alt. 5700 feet, *Gamble*, 17330.

*Distrib.* Endemic in the Nilghiris.

10. FIMBRISTYLIS SCHŒNOIDES, *Vahl*; *Hook. f. l. c.* vi. 634.

**1.** Kangra, *C. B. Clarke*, 24673. Gurhwal, alt. 6000 feet, *Duthie*, 5011. Dehra Doon, *Duthie*, n. 2117. Nipal, *Wallich*, 3487 B 1 part (hb. propr.), 3490 A, B, C, D, E (hb. propr.).

**2.** Sind, *Pinwill.* Punjab, *T. Thomson*, 58. Mt. Aboo, *Duthie.*

**3.** Concan, *Woodrow.*

**4.** Ceylon, *Walker*, *Trimen*, *Thwaites*, 833.

**5.** Madras Peninsula, *Rottler*, *Wight*, 2882 part. (hb. Calcutta), 1867, 1868 (hb. propr.), 100, 101, 103 (hb. Berlin). Saugor, *Vicary*; Goona, *King*; Chunda, *Duthie*, 9877. Chota Nagpore, alt. 1000–3000 feet, common, *C. B. Clarke.*

**6.** Saharunpore, *Royle*, 70. Calcutta, *C. B. Clarke*, 33597; Serhampore, *Griffith.* Dacca, *C. B. Clarke*, 7862.

**7.** Sikkim Terai, frequent, *C. B. Clarke.*

**8.** Upper Assam, *Jenkins.* Mikir Hills, *Simons.* Khasia, alt. 1200–4000 feet, *Hook. f. & T. Thomson*, 23, common, *C. B. Clarke.* Sylhet, *C. B. Clarke*, 7110; Pundua, *J. D. Hooker*, 400. Chittagong, *J. D. Hooker.*

**10.** Pegu, *Kurz*, 633. Burma, *Falconer*, 1188 (1158 hb. Berlin). Moulmein, *Parish*, 65.

**11.** Penang, *King.* Singapore, *Kurz.*

*Distrib.* China. Malaya. Queensland.

11. FIMBRISTYLIS SUB-BISPICATA, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 634.

**6.** Orissa, Poori, *W. S. Atkinson* (21730 hb. C. B. Clarke).

*Distrib.* China. Japan. [Var. in Bourbon, Java.]

FIMBRISTYLIS SUB-BISPICATA, *Nees*:

Var. *β.* TENUISSIMA, *i. e.* Fimb. ferruginea, var. ? tenuissima, *C. B. Clarke in Hook. f. l. c.* vi. 639.

**4.** Ceylon, *Mrs. Marriott* (hb. Delessert).

*Distrib.* Endemic in Ceylon.

12. FIMBRISTYLIS DIPSACEA, *Benth.*; *Hook. f. l. c.* vi. 635.

**4.** Ceylon, *Leschenault*, *Thwaites*, 668.

**5.** Madras Peninsula, *Wight*, 1865, 2894 part (hb. Calcutta), 107, 107 B (hb. Berlin), *G. Thomson*, 330. Pondicherry, *Perrottet*, 372. Central India, Goona, *King*, 43.

**6.** Bengal, Kissengunje, *King*, 2046. R. Megna, *J. D. Hooker*, 179. North and East Bengal, common, *C. B. Clarke.*

**8.** Kamroop, *Buchanan Hamilton*, 188. Khasia, hb. Calcutta. Chittagong, *C. B. Clarke*, 6596.

**9.** Yunan, *J. Anderson.*

**10.** Pegu, *Kurz*, 620, 2709. Burma, *Wallich*, 3478 part, *Griffith*, Kew n. 6287.

*Distrib.* Amurland. Congo. Canton. Philippines.

13. FIMBRISTYLIS SQUARROSA, *Vahl*; *Hook. f. l. c.* vi. 635.

**1.** Kashmir, *Jacquemont*, 1119. Nepal, *Wallich*, 3479 D (hb. propr.).

**2.** Mt. Aboo, *King.*

**6.** Moradabad, *T. Thomson*, 491. Lower Bengal, *Wallich*, 3479 A part, B, C, E (hb. propr.); R. Megna, *J. D. Hooker*, 230. Julpigori, *Buchanan Hamilton*, 185. Malda and Pubna, *C. B. Clarke.*

**8.** Assam, *Simons.* Dibroo-gurh, *C. B. Clarke*, 37721. Khasi Hills, *Hook. f. & T. Thoms.* Comilla, *C. B. Clarke.* Chittagong, *J. D. Hooker*, 287.

**9.** Bhamo, *J. Anderson.*

**10.** Burma, *Wallich*, 3478 C, 3517 C part. (hb. propr.).

*Distrib.* Mediterranea. Mongolia. Ethiopia. Indo-China. otropica. [Var. in Oceania.]

14. FIMBRISTYLIS DICHOTOMA, *Vahl*; *Hook. f. Fl. Brit. Ind.* vi. 635.

1. Gilgit, *Winterbottam*, 921. Kashmir, *Jacquemont*, 668, *Schlagintweit*, 4530, 12947; alt. 5000 feet, *Levinge*. Kanaor, *Jacquemont*, 1122. Kumaon, alt. 4000 feet, *Strachey & Winterbottom*, 3. Kangra, *C. B. Clarke*, 24671. Debra Dhoon, *King*, *Duthie*, 2459; Rulloo, *Brandis*, 3322.
2. Peshawur, *Stewart*, 92. Punjab, *Schlagintweit*, 10494, *T. Thomson*, 58, *C. B. Clarke*, 28165. Meerut, *T. Thomson*, 103. Sind, *Stocks*, 1204, *Dalzell*. Mt. Aboo, *King*.
3. Bombay, *Dalzell*, *Lambert*. Concan, *Stocks*. Asseergurh, *Wallich*, 3511 D (hb. Calcutta).
4. Ceylon, *Thwaites*, 3758.
5. Madras Peninsula, *Wallich*, 3509 E, 3512 B (hb. propr.), *Wight*, 1879 (hb. Kew), 2903, 2908 part (hb. Calcutta), 2898 (hb. Paris), 82, 83, 1875 part (hb. Berlin). Maisor, *G. Thomson*. Central India, *King*, 22, 49; Saugor, *Vicary*; Chunda, *Duthie*, 9861. Chota Nagpore, *Wood*.
6. Saharunpore, *Royle*, 45, 47, 46 (hb. Berlin). Oudh, *R. Thompson*, 361. Etawah, *Duthie*, 4915. Behar, *J. D. Hooker*, 629; Monghyr, *Buchanan Hamilton*, 181. Bengal, common, *C. B. Clarke*. Lower Bengal, *Wallich*, 3511 (hb. propr.), 3515 (hb. propr.), 3517 A (hb. propr.), 3516 B (hb. propr.). Calcutta, *Gaudichaud*, 337, *Buchanan Hamilton*, 178.
7. Nepal, *Wallich*, 3516, 3511 D (hb. Kew), 3511 E (hb. Calcutta).
8. Assam, *Griffith*, 1464, 1473, 1585, *Masters*, *Jenkins*, *Simons*. East Bengal, *Griffith*, Kew n. 6310.

10. Pegu, *Kurz*, 630, 631. R. Irrawaddi, *Wallich*, 3517 (hb. Calcutta). Attran, *Wallich*, 3515 A, B (hb. Kew). Moulmein, *Falconer*, 6. Andamans, *Kurz*.

*Distrib.* Palæarctica. Ethiopia. Indo-China. Oceania.

15. FIMBRISTYLIS DIPHYLLA, *Vahl*; *Hook. f. l. c.* vi. 636.

1. Kashmir, *Jacquemont*, 1390; alt. 6700 feet. *Levinge* (hb. C. B. Clarke, 24186), *Atkinson* (hb. C. B. Clarke, 24185); Chumba, alt. 3000 metr., *C. B. Clarke*. Simla, alt. 5000 feet, *Gamble*, 4824. Gurhwal, alt. 6000 feet, *Duthie*, 5013. Dehra Dhoon, *Vicary*, *King*, *Duthie*, 2112. Kumaon, *King*, *Duthie*, 9.

**2.** Sind, *Pinwill*, *Schlagintweit*, 11465. Umritsur, *C. B. Clarke*, 22221. Mt. Aboo, *King*.

**3.** Canara, *Talbot*, 601. Nilgiri Mts., *Hohenacker*, 941, *Perrottet*, 1207, 683. Canoor, *MacIvor*, 78. Anamallay Hills, *Beddome*.

**4.** Ceylon, *Leschenault*, *Thwaites*, 838, 839, 840, 841, 3232, 3757, *Wichura*, 2692, *Ploem*, 479.

**5.** Madras Peninsula, *Wight*, 1871 part, 1872 part, 1873, 1874, 1874 *b*, 1875, 1876 (hb. propr.), 2901 (hb. Paris, Berlin), 91, 96 (hb. Berlin), *Wallich*, 3506 C part, 3507 A, B, 3509 A, B, C, D, F, 3512 B, 3521 B, 3525 A part. (hb. propr.). Pondicherry, *Perrottet*, 529. Central India; Goona, *King*; Chunda, *Duthie*, 9863, 9864, 9867. Chota Nagpore, common, *C. B. Clarke*.

**6.** Moradabad, *T. Thomson*, 320. Bengal, *Buchanan Hamilton*, 180, *Wallich*, 3501, 3508 (hb. propr.), *Griffith*, Kew n. 6321 (hb. Berlin), common, *C. B. Clarke*. Orissa, *Atkinson*, 21735 (hb. C. B. Clarke).

**7.** Sikkim, alt. 0–5500 feet, *T. Anderson*, 1339, 1340; common, *C. B. Clarke*.

**8.** Assam, *Griffith*, 1463, Kew n. 6312 (hb. Berlin); Sudiya, *Griffith*, Kew n. 6334; Kohima, alt. 4600 feet, *C. B. Clarke*, 41225. Khasia, common, *C. B. Clarke*. Sylhet, *Wallich*, 3503 C part (hb. propr.). Chittagong, *C. B. Clarke*, 19776.

**9.** Ava, *Wallich*, 3513.

**10.** Pegu, *Kurz*, 624, 625, 632, 687. Arracan, *Kurz*. Burma, *Griffith*, Kew n. 6342. Mergui, *Griffith*, 153, Kew n. 6350. Andamans, *Kurz*. Nicobars, *Kurz*, 25977 (hb. C. B. Clarke).

**11.** Penang, *Delessert*, *King*. Perak, *Wray*, 604. Malacca, *Griffith*, Kew n. 6322, 6345. Singapore, *Gaudichaud*, 117, *Jagor*, 80, *Ridley*, 29.

*Distrib.* Palæarctica. Ethiopia. Indo-China. Oceania. U.S. Neotropica.

FIMBRISTYLIS DIPHYLLA, *Vahl*:

Var. *β*. NILAGIRICA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 637.

**3.** Nilghiri Mts, Pykara, *King*.

*Distrib.* Endemic in Nilghiris.

16. FIMBRISTYLIS STOLONIFERA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 637.

**8.** Khasia, alt. 2000–6000 feet, *J. D. Hooker*, 1312, 1488, *C. B. Clarke*, 7315, 38348, 38975, 43297. "Nepal vel Bengal" (an Khasia? *C. B. Clarke*), *Wallich*, 3503 A, B, C part (hb. propr.).

**9.** Muneypoor, *Watt*.

*Distrib.* Endemic in Khasia and Muneypoor.

FIMBRISTYLIS STOLONIFERA, *C. B. Clarke*:

Var. β. LUDENS, *C. B. Clarke in Hook. f. l. c.* vi. 637.

**8.** Khasia, alt. 2000 feet, *C. B. Clarke*, 43292.

*Distrib.* Endemic in Khasia.

17. FIMBRISTYLIS ÆSTIVALIS, *Vahl*; *Hook. f. l. c.* vi. 637.

**3.** Malabaria, *Stocks*, *Law*. Bombay, *Dalzell*. Canara, *Talbot*, 551. Wynaad, *Levinge* (n. 34503 herb. C. B. Clarke). Nilghiri Mts., Pykara, alt. 6900 feet, *Gamble*, 11840.

**4.** Ceylon, *Thwaites*, 3943.

**5.** Madras Peninsula, *Rottler*, *Wight*, 1880. Central India, Chunda, *Duthie*, 9858, 9859.

**6.** Patna, *Buchanan Hamilton*, 182, 184, *Wallich*, 3479 *a* part (hb. propr.). Julpigori, *Buchanan Hamilton*, 187, *Wallich*, 3475 (hb. propr.), 3479 (hb. propr.). Kissengunj, *T. Anderson*, 2036. Dacca, common, *C. B. Clarke*. Bengal, *Wallich*, 3517 *a*, B, C part, D, E (hb. propr.).

**7.** Nipal, *Wallich*, 3516 A (hb. propr.). Sikkim, *J. D. Hooker*, *Kurz*. Siligori, *C. B. Clarke*, 26451.

**8.** Assam, *Griffith*. 1582, 1595; Seebsagur, *Jenkins*, 1585; Tezpore, *C. B. Clarke*, 37658. East Bengal, *Griffith*, Kew n. 6310, 6332, 6333. Chittagong, *Lister*.

**10.** Pegu, *Falconer*, 13, *Kurz*, 630, *Bélanger*, 209. Mergui, *Griffith*, Kew n. 6331. Moulmein, *Helfer*, 232 (292 hb. DC.). Tavoy, *Wallich*, 3517 C, E (hb. Berlin). Tenasserim, *Helfer*, Kew n. 6309, 6333; R. Kimba, *Kunstler*, 349, 399.

**11.** Perak, Isle Sambilang, *Kamphoevener*. Malacca, *Griffith*, Kew n. 6311. Pahang, *Ridley*, 43, 1268.

*Distrib.* China. Japan. Malaya. Australia. Polynesia.

[The Brasilian *F. limosa*, Kunth, is very near *F. æstivalis*, and might be regarded as a var. of it.]

18. FIMBRISTYLIS SCABERRIMA, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 637.

**8.** Sylhet, *Wallich*, 3507 C (herb. propr., Mus. Brit., Kew, Paris, Berlin, Calcutta).

*Distrib.* Endemic in Sylhet. (Probably only once collected.)

19. FIMBRISTYLIS PODOCARPA, *Nees*; *Hook. f. l. c.* vi. 638.

**1.** Mussooree, *Royle*, 77; Choor, *Royle*, 68.

**5.** Chota Nagpore, *C. B. Clarke*, 20818, 20850, 33815.

**6.** Saharunpore, *Royle*, 72, *Lemann* (hb. Boissier). Kawnpore, *Duthie*, 7671. Dacca, *C. B. Clarke*, 7609, 17206.

**7.** Sikkim Terai, *C. B. Clarke*, 36986.

**8.** East Bengal, *Wallich*, 3521 A mainly, 3319 part (hb. DC.), *Griffith*, Kew n. 6313 part (hb. Kew). Upper Assam, *Jenkins*, 213. Khasia, *Hook. f. & T. Thoms.*, *Mann*, 155 part.

*Distrib.* Hongkong. Java. Ins. Marianne. Rio Janeiro?

20. FIMBRISTYLIS FUSCINUX, *C. B. Clarke in Hook. f. l. c.* vi. 638.

**6.** Moradabad, *T. Thomson*, 205.

**7.** Sikkim Terai: near Dulkajhar, *C. B. Clarke*, 11657, 36747, 36748.

*Distrib.* Endemic in Moradabad and Sikkim Terai.

21. FIMBRISTYLIS ALBOVIRIDIS, *C. B. Clarke in Hook. f. l. c.* vi. 638.

**8.** East Bengal, *Griffith*, Kew n. 6313 (hb. Calcutta). Upper Assam, *Jenkins*, 212 (hb. Kew, Calcutta). R. Megna, *J. D. Hooker*, 230, 203.

*Distrib.* Endemic in Assam.

22. FIMBRISTYLIS FERRUGINEA, *Vahl*; *Hook. f. l. c.* vi. 638.

**1.** Rawul Pindee, *Aitchison*, 242.

**2.** Punjab, *Schlagintweit*, 2726, 11957, *Hook. f. & T. Thoms.*, 58. Peshawur, *Stewart*, 299. Sind, *Pinwill.* Mt. Aboo, *King.* Marwar, *Duthie*, 4916.

**3.** Malabaria, *Stocks*, *Law.* Bombay, *Dalzell*, *Jacquement*, 412, *Ralph.* Concan, *Talbot*, 528. Poona, *Woodrow*, 131, 247.

**4.** Ceylon, *Leschenault*; Kokoole Corle, *Gardner* (*Thwaites*, n. 848).

**5.** Tranquebar, *Rottler*, 224, 641. Madras Peninsula, *Wight*, 97, 98, 99 (hb. Berlin), 1869 (hb. propr.), 2897 part (hb. Calcutta), *Rottler*, 87, 575 (hb. DC.), *Wallich*, 3506 A, B part, C part, D (hb. propr.), 3522, 3521 (hb. Calcutta). Chingleput, *Gamble*, 17190. Saugor, *Vicary*. Goona, *King*.

**6.** Gangetic Plain, common near the sea, *C. B. Clarke*.

**8.** Sillet, *Wallich*, 3526 (hb. DC.).

**10.** Pegu, *Kurz*, 625 *b*, 633, 640, 2694, 2716. Arracan, *Kurz*. Burma, *Griffith*, Kew n. 6346, 6347. Mergui, *Griffith*, 152, Kew n. 6347. Andamans, *Kurz*. Nicobars, *Kurz*. Amherst, *Wallich*, 3527 (hb. propr.).

**11.** Penang, *Didrichsen*, 3477. Malacca, *Griffith*, Kew n. 6346. Singapore, *Kurz*. Kelantan, *Ridley*.

*Distrib.* Mediterranea. Ethiopia. China. Malaya. Oceania. Bahamas. Neotropica.

23. FIMBRISTYLIS COMPRESSA, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 639.

**5.** Madras Peninsula, *Roxburgh*, *Wight*, 2385, 2902.

**10.** Mergui, *Griffith*, 293, Kew. n. 6343. Tenasserim, *Helfer*, Kew n. 6814/3.

*Distrib.* Endemic in Madras and Pegu.

24. FIMBRISTYLIS LONGISPICA, *Steud.*; *Hook. f. l. c.* vi. 639.

**11.** Pahang, *Ridley*, 1549.

*Distrib.* China. Japan. [The American *F. spadicea*, Vahl, is hardly distinct as a species from this.]

25. FIMBRISTYLIS RIGIDULA, *Nees*; *Hook. f. l. c.* vi. 640.

**1.** West Himalaya, *Jacquemont*, 902. Dhargoun, *Royle*, 53 (hb. propr.). Kunawur, *Royle*, 60 (hb. propr.). Mussoorie, *King*. Simla, alt. 5000 feet, *Gamble*, 4512, 4513. Chyal, alt. 5500 feet, *Brandis*, 1454; in valle Jumna, *Jacquemont*, 791. Kuntagong, *T. Thomson*, 205. Kumaon, alt. 5700 feet, *Strachey & Winterbottom*, 4, *T. Thomson*, 1166. Nepal, *Wallich*, 3516 A (hb. Delessert), 3519 part (hb. propr., Mus. Brit.).

**6.** Saharunpore, *Royle*, 74. Dacca, *C. B. Clarke*, 8445, 16984.

**9.** Muneypoor, *Watt*, 7414. Shan Hills, alt. 5500 feet, *Collett*, 397.

*Distrib.* China. Philippines.

26. FIMBRISTYLIS SPATHACEA, *Roth*; *Hook. f. Fl. Brit. Ind.* vi. 640.

**2.** Sind, *Pinwill.* Marwar, *Duthie*, 4920.

**4.** Ceylon, *Reynaud*; Trincomalee, *Beddome*, *Thwaites*, 3759.

**5.** Tranquebar, *Rottler*, 220, *Didrichsen*, 3845. Madras Peninsula, *Wallich*, 3309, *Wight*, 1872, 1872 *b* (hb. propr.), 1874 *b* (hb. Kew), 94 (hb. Berlin). Madras, *Shuter*. Nellore, *Gamble*, 12782.

**6.** Orissa, Poori, *W. S. Atkinson.*

**10.** Andamans, *Kamphoevener*, 668, 669.

**11.** Singapore, *Schottmueller*, 457.

*Distrib.* Ethiopia. Arabia. China. Malaya. Neotropica.

27. FIMBRISTYLIS ARGENTEA, *Vahl*; *Hook. f. l. c.* vi. 640.

**4.** Ceylon, *Leschenault*, *Thwaites*, 2877.

**5.** Coromandelia, *Bélanger*, 214. Madras Peninsula, *Wallich*, 3483 (hb. propr.), *Wight*, 1878 (hb. propr.), 77 (hb. Berlin), 2876 (hb. Paris, Calcutta), *Rottler*, 31. Madras, *T. Thomson*, 459, *Griffith.* Maisor, *G. Thomson*, *Hook. f. et T. Thoms.*, 21. Trichinopoly, *G. King.* Pondicherry, *Perrottet.* Cuddapah, *Beddome.* Central India, Chunda, *Duthie*, 9840, 9860.

**6.** Lower Bengal, *Kurz.*

**11.** Kelantan, *Ridley* (hb. Mus. Brit.).

*Distrib.* Endemic in India, *probably*; Boeckeler says it inhabits Mauritius—where, however, it is unknown to Baker. But it is likely to grow in Mauritius, or to be carried thither.

28. FIMBRISTYLIS ALBICANS, *Nees*; *Hook. f. l. c.* vi. 641.

**5.** Madras Peninsula, *Wight*, 1877 (hb. propr.), *Wallich*, 3482 (hb. propr.), *Heyne* (hb. Copenhagen).

*Distrib.* Endemic in Madras. (Probably only two collections—Wight's and Heyne's.)

29. FIMBRISTYLIS HOOKERIANA, *Boeck.*; *Hook. f. l. c.* vi. 641.

**5.** Chota Nagpore; Gurhma (in Lohardugga), alt. 2000 feet, *C. B. Clarke*, 33981.

**8.** Khasia, alt. 1800–4500 feet, *Griffith*, 26, 307, Kew n. 6320, *J. D. Hooker*, 2040, common, *C. B. Clarke.*

*Distrib.* Endemic in Chota Nagpore and Khasia.

30. FIMBRISTYLIS SERICEA, *R. Br.*; *Hook. f. Fl. Brit. Ind.* vi. 641.

**5.** Ganjam, *Lawson.*

**6.** Orissa, Poori, *W. S. Atkinson.*

**11.** Singapore, *Ridley*, 4.

*Distrib.* China. Japan. Malaya. North Australia.

31. FIMBRISTYLIS TENERA, *Roem. et Sch.*:

Var. *β.* OXYLEPIS, *C. B. Clarke in Hook. f. l. c.* vi. 642.

**2.** Lahore, R. Chenab, and the Beas Doab, *T. Thomson.* Sind, *Pinwill.* Ajmere, *Jacquemont*, 209.

**3.** Mangalore, *Metz*, 131 *a.*

**5.** Coromandelia, *Bélanger*, 204. Bellary, alt. 1000 feet, *Gamble*, 17763. Central India, Goona, *King.* Chota Nagpore, alt. 2000 feet, *C. B. Clarke*, 21238.

**6.** Saharunpore, *Lemann* (hb. Boissier). Moradabad, *T. Thomson.* Monghyr, *Buchanan Hamilton*, 183, *Wallich*, 3514 B, E part (hb. propr.). Bengal, *Wallich*, 3531 (hb. propr.). Calcutta, *J. D. Hooker*, *Kurz*; Serampore, *Griffith.* Mymensingh, *C. B. Clarke*, 7945.

**8.** Assam, *Griffith* (hb. Boissier). East Bengal, *Griffith*, Kew n. 6329 part (hb. Berlin).

*Distrib.* Endemic in India (*i. e.* Var. *β* is endemic; the species *F. tenera* grows in Trop. Africa and Socotra).

FIMBRISTYLIS TENERA, *Roem. et Sch.*:

Var. *γ.* OBTUSATA, *Ridley*; *Hook. f. l. c.* vi. 642.

**6.** Lower Bengal, *Wallich*, *Kurz.*

**11.** Penang, *Didrichsen*, 3455. Singapore, *Ridley*, 83, 1740 *a.*

*Distrib.* Borneo.

32. FIMBRISTYLIS MONTICOLA, *Steud.*; *Hook. f. l. c.* vi. 642.

**3.** Bombay, Shelarwadi, *Woodrow*, 10. Nilghiri Mts., *Hohenacker*, 940. Anamallay Mts., alt. 4250 feet, *Beddome.* Cannanore, *Campbell.* Pulney Hills, *Beddome.*

**4.** Ceylon, *Beddome*; Ambagamowa District, *Thwaites*, 3780.

**5.** Madras Peninsula, *Wallich*, 3514 A (hb. propr.).

*Distrib.* Endemic in (Southern) India. (Wallich 3514 A came perhaps from Malabaria.)

33. FIMBRISTYLIS MERGUENSIS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 642.

**10.** Mergui, *Griffith*, 384, Kew n. 6330. Tenasserim, *Helfer*, 384, Kew n. 6330.

*Distrib.* Endemic in Tenasserim. (Possibly only once collected.)

34. FIMBRISTYLIS PIEROTII, *Miq.*; *Hook. f. l. c.* vi. 642.

**1.** Simla, alt. 7500 feet, *T. Thomson*; alt. 4500 feet, *Gamble*, 4513 C. Kumaon, alt. 9000 feet, *Duthie*, 6087, 6088.

*Distrib.* Japan.

35. FIMBRISTYLIS ARNOTTIANA, *Boeck.*; *Hook. f. l. c.* vi. 643.

**5.** Cannanore, *Campbell.* [Madras Peninsula, *Wight*, 1884, right-hand example (hb. propr.), and hb. Mus. Brit.]

*Distrib.* Cannanore, once collected, *i. e.* in this case there is strong reason to believe that the material in Wight's herbarium all came from Campbell. The very large quantity of examples of the "Madras Herb." without further locality are referred generally to "Coromandelia"; but perhaps 10 per cent. of them came from "Malabaria"; and not a few came from the Malay Peninsula.

36. FIMBRISTYLIS FILIFOLIA, *Boeck.*; *Hook. f. l. c.* vi. 643.

**7.** Sikkim Terai, Dulkajhar, alt. 500 feet, *C. B. Clarke*, 36731, 36950.

**8.** Khasia, Cherra, alt. 4000 feet, *J. D. Hooker*, 1067, *C. B. Clarke*, 7285.

*Distrib.* Endemic in Sikkim and Khasia.

37. FIMBRISTYLIS ASPERRIMA, *Boeck.*; *Hook. f. l. c.* vi. 643.

**4.** Ceylon, *Leschenault*, *Thwaites*, 837.

**10.** Tavoy, *Wallich*, 3502 B part (hb. propr., DC.), 3525 E part (hb. propr.).

**11.** Penang, *Curtis*, 1595; *Kunstler*, 1498 B; alt. 2500 feet, *Rink.* Perak, *Wray*, 841. Malacca, *Griffith*, Kew n. 6349. Singapore, *Ridley*, 1793.

*Distrib.* Malay Islands.

38. FIMBRISTYLIS QUINQUANGULARIS, *Kunth*; *Hook. f. l. c.* vi. 644.

**1.** Dehra Dhoon, *Royle*, 67 (hb. propr.), 43 (hb. propr.).

Nynee Tal, *Davidson.* Nepal, *Wallich*, 3499 A, B, C (hb. propr.), 3499 B, C (hb. Kew, Calcutta mainly), 3500 F (hb. Kew), 3512 A, C, D (hb. propr.).

**2.** Punjab, *T. Thomson.* Umritsur, *C. B. Clarke*, 22218.

**3.** Bombay, *Boivin*, 987. Concan, *Law.*

**4.** Ceylon, *Leschenault*; not uncommon, *Thwaites*, 838.

**5.** Tinnevelly, *Beddome.* Madras Peninsula, *Wight*, 1884 (137 hb. Berlin), *Wallich*, 3517 (hb. Munro). Madras, *G. Thomson*, 444. Central India: Saugor, *Vicary*; Goona, *King*; Chunda, *Duthie*, 9868, 9869. Chota Nagpore, *J. D. Hooker*, 628; common, *C. B. Clarke.*

**6.** Saharunpore, *Lemann*; Delhi, *C. B. Clarke*, 23383. Monghyr, *Buchanan Hamilton*, 176. Bengal, *Wallich*, 3515 part (hb. Calcutta); Burisaul, *Buchanan Hamilton*, 177; common, *C. B. Clarke.*

**7.** R. Tambur (Nepal), *J. D. Hooker.*

**8.** Assam, *Simons*; Khasi hills, *J. D. Hooker*, 1566, 1922, *Griffith*, 165, 203, 1312, 1465. R. Barak, *Griffith*, Kew n. 6340. Sylhet, *C. B. Clarke*, 7099. Chittagong, *J. D. Hooker*, 454.

**9.** Muneypoor, alt. 3800 feet, *C. B. Clarke*, 41973.

*Distrib.* Ethiopia (one or two examples seen, perhaps introduced). Ningpo Mts. (China). Malaya. Queensland. Guiana (perhaps introduced with rice).—This plant, so superabundant in rice in India, would appear (from collections in herbaria in Europe) to be extraordinarily rare everywhere else.

FIMBRISTYLIS QUINQUANGULARIS, *Kunth*:

Var. β. CRASSA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 644.

**3.** Nilgiri Mts., *Hohenacker*, 1296; alt. 7500 feet, *C. B. Clarke*, 10910, *King*; alt. 5000 feet, *Gamble*, 11307, 12408, 17273. Anamallay Mts., alt. 4000 feet, *Beddome.*

**4.** Ceylon, *Walker*, *Thwaites*, 823 part.

*Distrib.* Java (frequent).

39. FIMBRISTYLIS MILIACEA, *Vahl*; *Hook. f. l. c.* vi. 644.

**1.** West Himalaya, *Royle*, 43, 45 (hb. propr.), 79 (hb. Berlin). Kashmir, alt. 6000 feet, *Schlagintweit*, 13175 *Levinge.* Kangra, alt. 3000 feet, *C. B. Clarke.* Nepal, *Wallich*, 3500 (3499 part in herb. Kew).

2. Punjab, *T. Thomson*; Sind, *Pinwill.*
3. Malabaria, *Stocks*, *Law*, *Bélanger*, 208. Bombay, *Lambert*; Travancore, *Wight*, 1276 (herb. Berlin).
4. Ceylon, *Walker*, *Leschenault*, *Watson*, 129, *Macrae*, 231; very abundant, *Thwaites*, 836.
5. Tranquebar, *Rottler*, *Didrichsen*, 3889. Madras Peninsula, *Wight*, 1883, 3524, 88 (herb. Berol.), 2900 (herb. Calcutta), 2898 (herb. Boissier), *Wallich*, 3524 (herb. propr.). Pondicherry, *Perrottet*, 516, *Reynaud*. Chingleput, *Gamble*, 17188. Chota Nagpore, alt. 1200–2000 feet, common, *C. B. Clarke*.
6. Moradabad, *T. Thomson*, 281. Bengal, common, *C. B. Clarke*; *Wallich*, 3500 E. Behar, *J. D. Hooker*. Calcutta, *Gaudichaud*, 336.
8. Assam, *Buchanan Hamilton*, 175, *Griffith*, 1602, *Jenkins*, 208, 211, 575, *Masters*, 267, *Simons*, 416. East Bengal, *Griffith*, Kew n. 6314 part, n. 6324. Khasia, alt. 5000 feet, *C. B. Clarke*, 19152. Chittagong, *J. D. Hooker*.
9. Ava, *Wallich*, 3500 G.
10. Pegu, *Kurz*, 626, 627. Moulmein, *O. Kuntze*, 6293. Mergui, *Griffith*, 294, Kew n. 6344. Tenasserim, *Helfer*, 269, Kew n. 6314, 6315, 6344. Tavoy, *Wallich*. Andamans, *Kurz*; Nicobars, *Kurz*.
11. Penang, *Curtis*, 1792. Malacca, *Griffith*, Kew n. 6314. Singapore, *Gaudichaud*, 116, *Wichura*, 694, *Jagor*, 158, *Ridley*, 30, 38.

*Distrib.* Ethiopia. South Persia. China. Japan. Malaya. Australia. Polynesia. Neotropica.

40. FIMBRISTYLIS GLOBULOSA, *Kunth*; *Hook. f. Fl. Brit. Ind.* vi. 644.

3. Bombay, *Cooke*.
4. Ceylon, *Macrae*, 174, *Walker*, *Thwaites*, 842.
6. Bengal, *Griffith*, Kew n. 6316. Jheels, *J. D. Hooker*. Dacca, frequent, *C. B. Clarke*.
7. Nepal, *Wallich*, 3517.
8. Assam, *Griffith*, 1486, *Jenkins*, 210, 213. Gowhatty, *Simons*, 422. Seebsagur, *C. B. Clarke*, 40766.
9. Shan Hills, alt. 2000 feet, *Collett*.
10. Pegu, *Kurz*, 634. Rangoon, *Wallich*, 3529 (herb. propr.). Mergui, *Griffith*, Kew n. 6317. Tenasserim (or Anda-

mans?), *Helfer*, Kew n. 6314/1, 6314/2, 6316, 6317, 6348.

**11.** Penang, *Wallich*, 3518 (herb. propr.), *Delessert*, *King*. Malacca, *Griffith*, Kew n. 6348, *Delessert*, *Jagor*, 288. Singapore, *Wichura*, 695, *Kurz*, *O. Kuntze*.

*Distrib.* China. Malaya. Marianne Isles.

FIMBRISTYLIS GLOBULOSA, *Kunth*:

Var. β. TORRESIANA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 645.

**6.** Bengal, R. Megna, *J. D. Hooker*.

**8.** Assam, *Masters*.

*Distrib.* Japan. Marianne Isles.

FIMBRISTYLIS GLOBULOSA, *Kunth*:

Var. γ. VICARYI, *C. B. Clarke in Hook. f. l. c.* vi. 645.

**1.** Dehra Dhoon, *Vicary*.

**2.** Punjab, on the banks of the Chenab, *T. Thomson*.

*Distrib.* Endemic in North-west India.

41. FIMBRISTYLIS INSIGNIS, *Thwaites*; *Hook. f. l. c.* vi. 645.

**3.** Anamallay Mts., *Beddome*.

**4.** Between Negombo and Kornegalle, *Thwaites*, 3317.

**5.** Cuddapah, *Beddome*.

*Distrib.* Canton. Tonkin. Borneo.

42. FIMBRISTYLIS PENTAPTERA, *Kunth*; *Hook. f. l. c.* vi. 645.

**4.** Ceylon, *Gardner*, 959; up to 6000 feet alt. (Newera Ellia, &c.), *Thwaites*, 823 part, 843.

**5.** Madras Peninsula, *Wight*, 2904 part (herb. Calcutta).

*Distrib.* Endemic in South India.

43. FIMBRISTYLIS COMPLANATA, *Link*; *Hook. f. l. c.* vi. 646.

**1.** Mussooree, *Royle*, 44.

**2.** Sind, *Pinwill*.

**3.** Poona, *Cooke*. Wynaad, *Rottler*.

**4.** Ceylon, *Leschenault*, *Beckett*, 550, *Thwaites*, 3220.

**5.** Madras Peninsula, *Wight*, 1882 *b*, 2899 (herb. Calcutta, Berlin), *Wallich*, 3510 (herb. propr.), 3525 A part, B, C, D, F (herb. propr.). Kurnool, alt. 1000 feet, *Gamble*, 17741. Central India, Chunda, *Duthie*, 9862, 9865.

**6.** Saharunpore, *Lemann*; Bengal, *Griffith*, Kew n. 6339 part. Soondreebun, *Buchanan Hamilton*, 174, common, *C. B. Clarke*.

8. Assam, *Mann*, 384. Khasia, *Griffith*, *J. D. Hooker*, 1933; frequent, *C. B. Clarke*.

9. Muneypoor, alt. 3300 feet, *C. B. Clarke*, 42024.

10. Burma, *Brandis*, *Kurz*, 2688, 2692. Tavoy and Attran, *Wallich*, 3502 A, B part (herb. propr.). Moulmein, *O. Kuntze*, 6783 *b*. Nicobars, *Kurz*.

11. Penang, *King*.

*Distrib.* Ethiopia. Indo-China. Oceania. Neotropica.

FIMBRISTYLIS COMPLANATA, *Link*:

Var. β. MICROCARPA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 646.

1. Kumaon, alt. 7000 feet, *Strachey & Winterbottom*, 2.

3. Bombay, Hewra, *Dalzell*.

7. Sikkim, alt. 10,000 feet, *J. D. Hooker*.

*Distrib.* China. Japan. Australia.

FIMBRISTYLIS COMPLANATA, *Link*:

Var. γ. KRAUSSIANA, *C. B. Clarke in Hook. f. l. c.* vi. 646.

4. Ceylon, *Gardner*, 963. Maturatta District, *Thwaites*, 2967.

*Distrib.* Cape. Madagascar. China. Japan.

FIMBRISTYLIS COMPLANATA, *Link*:

Var. δ. FENESTRATA, *C. B. Clarke in Hook. f. l. c.* vi. 646.

5. Madras Peninsula: Palimcotta, *Wight*, 2899 (herb. Kew, Paris), 1882 (herb. Berlin).

*Distrib.* Endemic (probably only once collected at Palimcotta).

*43. FIMBRISTYLIS WOODROWI, sp. nova.

Glabra, gracilis. Radices fibrosæ. Culmi 3-4 unc. longi, cæspitosi. Folia cum $\frac{1}{2}$–$\frac{2}{3}$ parte culmi æquilonga, $\frac{1}{20}$ unc. lata, plana. Umbella $\frac{1}{2}$ unc. in diam., sub-composita, 8–18-stachya; bracteæ 2–3, ima umbellam sæpe superans. Spiculæ (sæpe geminatæ) $\frac{1}{8}$ unc. longæ, $\frac{1}{24}$ unc. latæ, teretes, 20-floræ, pallide ferrugineæ. Glumæ spiraliter sitæ, arctius imbricatæ, ovatæ, ferrugineo-bruneæ carinâ viridi. Stamen (sæpe) 1. Stylus longus, glaber, deciduus; styli-basis pyramidalis, in nuce constricta, cum stylo deciduus nec coloratus; styli rami 3, longi. Nux cum $\frac{2}{3}$ parte glumæ æquilonga, anguste obovoidea, triquetra, straminea, longitudinaliter costata, inter costas horizontaliter trabeculata, interdum minute pauci-tuberculata.

3. Bhandalla (Bombay), *Woodrow*.

Only known by Woodrow's specimens.

44. FIMBRISTYLIS THOMSONII, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 646.

**5.** Chota Nagpore: Parasnath, alt. 4300 feet, *C. B. Clarke*, 13999, 34784, 34805.

**7.** Sikkim, *T. Anderson*; Rinchimpoong, *Rémy*, 145. Buxa, *Gamble*, 6852 C.

**8.** Assam, *Griffith*, Kew n. 6336, *Jenkins*, *Simons*; Nowgong, *C. B. Clarke*, 43203. Khasia, alt. 500-4200 feet, *Hook. f. & T. Thoms.*, *Wallich*, 3525 F part (herb. Berlin), *C. B. Clarke*, 7254, 37546, 38090, 38121, 43290, 43769.

**9.** Shan Hills, alt. 4000 feet, *Collett*, 753.

**10.** Pegu, *Kurz*, 628, *Brandis*, 1018 bis. Burma, *Griffith*, Kew n. 6322. Martaban, *Kurz*, 636. Karen Hills, *Kurz*, 637.

*Distrib.* China. Tonkin.

45. FIMBRISTYLIS SALBUNDIA, *Kunth*; *Hook. f. l. c.* vi. 646.

**8.** Silhet, *Wallich*, 3526 (herb. Kew, Calcutta, propr., *not* herb. DC.), 3499 C (herb. Berlin, *not* herb. propr.). Khasia, *Lemann* (herb. Griffith).

**10.** Amherst, *Wallich*, 3527 (herb. DC.).

*Distrib.* North Australia.

46. FIMBRISTYLIS LEPTOCLADA, *Benth.*; *Hook. f. l. c.* vi. 647.

**4.** Ceylon, *Thwaites*, 3047 (herb. Mus. Brit.); near Galle, *Thwaites*, 3760.

**11.** Malacca, *Griffith*, Kew n. 6351.

*Distrib.* South China. Borneo.

47. FIMBRISTYLIS PAUPERCULA, *Boeck.*; *Hook. f. l. c.* vi. 647.

**3.** Pulney Mts., *Wight*, 2896 in herb. Paris, Berlin (left-hand example in herb. Calcutta).

*Distrib.* Endemic in the Pulneys.

48. FIMBRISTYLIS JUNCIFORMIS, *Kunth*; *Hook. f. l. c.* vi. 647.

**1.** Kashmir, *C. B. Clarke*, 28140. Mussoorie, *Jacquemont*, 530. Gurhwal, *Jacquemont*, 582; alt. 4000 feet, *Duthie*, 72. Kumaon, alt. 6000 feet, *Strachey & Winterbottom*, *Duthie*, 5010. Kedarkanti, *Royle*, 54. Dehra Dhoon, *King*. Nepal, *Wallich*, 3503 part, 3519 part, 3520 D (herb. Delessert).

**2.** Hazara, *Stewart*. Lahore, *T. Thomson*. Sind, *Pinwill*.

**5.** Madras Peninsula, *Wight*, 1886, 1871 part (89 herb. Berlin), *Wallich*, 3520. Cuddapah, *Beddome*. Central

India: Saugor, *Vicary*; Chunda, *Duthie*, 9870. Chota Nagpore, alt. 2000 feet, *C. B. Clarke*, 33991.

**6.** Saharunpore, *Royle*, 41 (herb. propr.), 54 (herb. Berlin). Moradabad, *T. Thomson*, 205. Delhi, *C. B. Clarke*, 23405. Behar, *C. B. Clarke*, 27354; Monghyr, *Buchanan Hamilton*, 179. Bengal, *Griffith*, Kew n. 6327, 6335; common, *C. B. Clarke*.

**8.** Assam, *Wallich & Griffith*, *Simons*, *Griffith*, 1584.

**10.** Pegu, *Kurz*, 2688, 2689. Burma, *Wallich*, 3520 E.

*Distrib.* Manila.

FIMBRISTYLIS JUNCIFORMIS, *Kunth*:

Var. β. ABBREVIATA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 648.

**3.** Anamallay Mts., *Beddome*.

**4.** Ceylon, *Gardner*, 960; abundant among grass, *Thwaites*, 970, 837 (herb. Calcutta).

**5.** Madras Peninsula, *Wallich*, 3520 A part.

*Distrib.* Endemic in South India.

FIMBRISTYLIS JUNCIFORMIS, *Kunth*:

Var. γ. LATIFOLIA, *C. B. Clarke in Hook. f. l. c.* vi. 648.

**4.** Ceylon, *Walker*.

**5.** Madras Peninsula, *Wight*, 1885, 1887 (herb. propr.), 84 (herb. Berlin), 3498 (herb. propr.). Courtallum, *G. Thomson*, 98. Chingleput, *Gamble*, 17192.

*Distrib.* Endemic in South India.

49. FIMBRISTYLIS NIGROBRUNNEA, *Thwaites*; *Hook. f. l. c.* vi. 648.

**4.** Ceylon, *Fraser*, 32, *Jonville*; Matelle East, *Brodie*; south of the island, very abundant, *Thwaites*, 3779.

**5.** Courtallum, *Wight*, 1007, 2365 (herb. Berlin).

**8.** Khasia, alt. 3000–5000 feet, common, *C. B. Clarke*, *Griffith*, Kew n. 6338, 6352, *Wallich*, 3523, *J. D. Hooker*, 603, 1341.

**9.** Muneypoor, alt. 3600 feet, *Watt*, 6813.

**10.** Nicobars, —— (herb. Mus. Brit.).

*Distrib.* Cambodia.

50. FIMBRISTYLIS ULIGINOSA, *Steud.*; *Hook. f. l. c.* vi. 648.

**3.** Nilgiri Mts., *Hochstetter*, 1289, *Foulkes*, *Adam*, *Schmidt*, *Perrottet*, 682, *Wight*, 2896 (herb. Copenhagen); alt. 6500 feet, *Gamble*, 14309, 14541.

*Distrib.* Endemic in the Nilghiris.

51. FIMBRISTYLIS DIGITATA, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 648.

**3.** Bombay, *Dalzell*; Canara, *Law*, *Young*; Belekerri, *Talbot*, 491.

*Distrib.* Endemic in Malabaria.

52. FIMBRISTYLIS MONOSTACHYA, *Hassk.*; *Hook. f. l. c.* vi. 649.

**1.** West Himalaya, *Royle*, 40 (herb. Berlin).

**2.** Chenab Doab, *T. Thomson*. Sind, *Pinwill*.

**3.** Bombay, *Dalzell*. Poona, *Jacquemont*, 411. Canara, *Talbot*, 560. Nilgiri Mts., *Foulkes*. Anamallay Mts., *Beddome*.

**4.** Ceylon, *Thwaites*, 3231, 852 (herb. Paris).

**5.** Coromandelia, *Bélanger*, 197. Madras Peninsula, *Wight*, 1853, 2305 (104, 105 herb. Berlin), *Wallich*, 3491. R. Kistna, *Gamble*, 12738. Pondicherry, *Perrottet*. Vizagapatam, *Campbell*, 834. Central India: Goona, *King*; Chunda, *Duthie*, 9880.

**6.** Moradabad, *T. Thomson*, 256. North Bengal, *Buchanan Hamilton*, 129; Lower Bengal, *Wallich*, 3491, *Griffith*, 51, Kew n. 6293; throughout Bengal, frequent, *C. B Clarke*.

**8.** Assam, *Simons*.

**9.** Upper Burma, *Collett*, 846.

**10.** Tenasserim, *Helfer*, Kew n. 6293.

*Distrib.* Ethiopia. Indo-China. Oceania. Florida. Neotropica.

53. FIMBRISTYLIS TRISTACHYA, *Thwaites*; *Hook. f. l. c.* vi. 649.

**4.** Ceylon, north of the island, *Gardner*, *Thwaites*, 852.

**5.** Coromandelia, *Bélanger*, 198. Madras Peninsula, *Wight*, 1864, 2905 (106 herb. Berlin), *Didrichsen*, 3838. Tranquebar, *Rottler*, 230 (herb. propr.). Carnatic, *G. Thomson*. Nellore, *Gamble*, 12783. Chingleput, *Gamble*, 17186.

*Distrib.* Trop. Africa.

54. FIMBRISTYLIS FUSCA, *Benth. & Hook. f.*; *Hook. f. l. c.* vi. 649.

**6.** Bengal, *Wallich*, 3487 C part (herb. Calcutta). Burrakar, *Kurz*.

**7.** Nepal, *Wallich*, 353C (herb. propr.).

**10.** Pegu, *Kurz*, 2720 part, 2687; Tonkyeghat, *Kurz*, 623. Nicobars, *Kamphoevener*, 2484.

**11.** Penang, alt. 2800 feet, *Kunstler*, 1690.

*Distrib.* South China. Malaya. Moluccas.

55. FIMBRISTYLIS FULVESCENS, *Thwaites; Hook. f. Fl. Brit. Ind.* vi. 650.

**4.** Ceylon, *Walker*, 34 (herb. Delessert), *Beddome*; common in the Southern and Central Provinces up to 4000 feet, *Thwaites*, 679.

*Distrib.* Endemic in Ceylon.

56. FIMBRISTYLIS CYPEROIDES, *R. Br.*:

Var. *β*. CINNAMOMETORUM, *C. B. Clarke in Hook. f. l. c.* vi. 650.

**3.** Anamallay Mts., *Beddome.*

**4.** Ceylon, *Koenig. Walker, Macrae*, 158, *Leschenault, Thwaites*, 2752, *Wight*, 2032 (herb. Delessert).

**10.** Pegu, *Kurz*, 623, 2690 (herb. Calcutta).

*Distrib.* Canton.

57. FIMBRISTYLIS ACTINOSCHŒNUS, *C. B. Clarke in Hook. f. l. c.* vi. 650.

**4.** Ceylon, alt. 5500 feet, *Beckett*, 1038; Carawitta Kanda near Ratnapoora, and Dolosbage District, *Thwaites*, 3469.

*Distrib.* Endemic in Ceylon.

FIMBRISTYLIS ACTINOSCHŒNUS, *C. B. Clarke*:

Var. *β*. CHINENSIS, *C. B. Clarke in Hook. f. l. c.* vi. 651.

**11.** Perak, alt. 7000 feet, *Wray*, 354; alt. 1000 feet, *Kunstler*, 3373.

*Distrib.* Hongkong.

58. FIMBRISTYLIS DISTICHA, *Boeck.*; *Hook. f. l. c.* vi. 651.

**3.** Mangalore, *Metz* (herb. Mus. Brit.).

**10.** Moulmein, *Parish*, 67 part. Mergui, *Griffith*, 230, Kew n. 6337. Tavoy, *Wallich.* Tenasserim (vel Andamans), *Helfer*, Kew n. 6143/1.

*Distrib.* Cochinchina.

FIMBRISTYLIS DISTICHA, *Boeck.*:

Var. β. KURZII, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 651.

**6.** North Bengal, Titaliya, *Kurz.*

*Distrib.* Endemic at Titaliya.

1. BULBOSTYLIS BARBATA, *Kunth*; *Hook. f. l. c.* vi. 651.

**1.** Kashmir, 1500–4000 feet, *C. B. Clarke*, 21999, 24327, 24331, 31449. Gurhwal, 5000 feet, *Duthie*, 369. Kumaon, *Strachey & Winterbottom*, 3, *King.* Nepal, *Wallich*, 3497.

**2.** Punjab, *Duthie*, 5006. Sind, *Pinwill.*

**3.** Bombay, *Dalzell.* Canara, *Talbot*, 555. Mangalore, *Metz*, 269. Nilgiri Mts., *G. Thomson*, *Wight*, 1893 (herb. propr.), 1160 (herb. Paris), *Kurz*, *G. Thomson.*

**4.** Ceylon, *Burmann*, *Delessert*, *Leschenault*, *Thwaites*, 834.

**5.** Coromandelia, *Leschenault*, 635. Madras Peninsula, *Wallich*, 3497, *Rottler*, 218. Dindygul and Trichinopoly, *G. King.* Pondicherry, *Reynaud. Commerson*, *Perrottet*, 520, 526, 528. Nellore, *Gamble*, 12240, 12386. R. Kistna, *Gamble*, 12607. Central India: Saugor, *Vicary*; Goona, *King*; Khandwa, *Duthie*, 8453; Chunda, *Duthie*, 9848, 9851. Chota Nagpore, 750–2000 feet, *C. B. Clarke*, 20415, 20512, 20543, 21151, 25246, 33646; Parasnath, 4000 feet, *C. B. Clarke*, 21087. Sonthal Pergunnahs, *Gamble*, 10676.

**6.** Saharunpore, *Royle*, 50, 69 (49 in herb. Berlin). Bengal, *Wallich*, 3481, *C. B. Clarke*, 8530, 11633, 11639, 26496. Monghyr, *Buchanan Hamilton*, 195.

**7.** Sikkim, alt. 500 feet, *King*, *C. B. Clarke*, 36934.

**8.** Assam, *Jenkins*, *Buchanan Hamilton*, 203. Chittagong, *J. D. Hooker*, 334.

**9.** Ava, *Wallich.*

**10.** Pegu, *Oates.* Arracan, *Kurz.* Tenasserim, *Helfer*, Kew n. 6286; Wellesley, *King.*

**11.** Penang, *Delessert.* Malacca, *Maingay*, 3192. Singapore, *Kurz*, 3002.

*Distrib.* Ethiopia. Cabul. Indo-China. Oceania.

BULBOSTYLIS BARBATA, *Kunth*:

Var. β. PULCHELLA, *C. B. Clarke in Hook. f. l. c.* vi. 652.

**4.** Ceylon, *Walker*, 35, *Thwaites*, 829, 3761; Trincomalee, *Glennie*; Colombo, *Macrae*, 376.

**5.** Madras Peninsula, *Wallich*, 3480 B. Tuticorin, *Wight*, 2891. Pondicherry, *Perrottet*. Madras, *G. Thomson*, 143.

*Distrib.* Endemic in Ceylon and Coromandel.

2. BULBOSTYLIS SUBSPINESCENS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 652.

**6.** Orissa, Poori, *W. S. Atkinson* (hb. C. B. Clarke, 21724).

*Distrib.* Endemic (one collection only).

3. BULBOSTYLIS CAPILLARIS, *Kunth*:

Var. TRIFIDA, *C. B. Clarke in Hook. f. l. c.* vi. 652.

**1.** West Himalaya, 8500 feet, *Brandis*, 3320; Mussoorie, *Royle*, 51; Kumaon, 6000 feet, *Strachey & Winterbottom*, *Wallich*, 3415 D (in hb. Berlin); Simla, *Gamble*, 5159 F; Gurhwal, 6000 feet, *Duthie*, 5005; Dalhousie, 6200 feet, *C. B. Clarke*; Chini, *T. Thomson*, 1931. Nepal, *Wallich*, 3514.

**2.** Mt. Aboo, *King*.

**3.** Nilghiri Mts., *Perrottet*, 701, 703, 1185, *Hohenacker*, 939, *Schmidt*; Ooty, 8000 feet, *Gamble*, 13161, *King*, 1090.

**4.** Ceylon, *Gardner*, 964; Central Province, *Thwaites*, 851.

**5.** Madras Peninsula, *Wight*, 2029, 1892 *b* (hb. Delessert). Pulney Mts., *Wight*, 2892. Chota Nagpore, Parasnath, 4200 feet, *C. B. Clarke*, 21071, 21082, 33706.

**6.** Lower Bengal, *Wallich*, 3514, 3487 C part. (in hb. Calcutta).

**7.** Sikkim, *Gamble*, 6997, *King*, 3039, 5026; 10,000 feet, *J. D. Hooker*; 1000–7500 feet, frequent, *C. B. Clarke*.

**8.** East Bengal, *Griffith*, Kew n. 6328, 6329. Khasia, 4000–6000 feet, *Wallich*, 3476 (hb. propr.), *Griffith*, 572, *J. D. Hooker*, 582, *Gallatly*, 484, *G. Mann*, 401; common, *C. B. Clarke*. Kohima, 6500 feet, *C. B. Clarke*, 41179, 41883.

*Distrib.* (of Var. *trifida* only). Caucasus. Ethiopia. Indo-China. Queensland. Timor.

[*B. capillaris*, the type, is abundant from Canada to Argentina —not known in the Old World.]

4. BULBOSTYLIS PUBERULA, *Kunth*; *Hook. f. l. c.* vi. 652.

**4.** Ceylon, *Thwaites*, 834; common in the warmer parts of the island, fide *Thwaites*.

**5.** Coromandelia, *Bélanger*, 199. Madras Peninsula, *Wight*, 1892, 2890.

**10.** Mergui, *Griffith*, Kew n. 6353.

**11.** Malacca, *Kunstler*, 35, 36. Singapore, *Ridley*, 44, *Burbidge*.

*Distrib.* Malaya.

1. SCIRPUS FLUITANS, *Linn.*; *Hook. f. Fl. Brit. Ind.* vi. 653.

**3.** Nilgiri Mts., *Perrottet*, 1206, *Schmidt*, 54.

**4.** Ceylon, *Moon*, 26, *Walker*; Central Province, common, *Thwaites*, 835, 2634.

**5.** Madras Peninsula, *Wight*, 70.

**8.** East Bengal, *Griffith*, Kew n. 6226, 6227. Khasia, *Griffith*, 25; 3000–6000 feet, *J. D. Hooker*, 1416; frequent, *C. B. Clarke*.

*Distrib.* Palæarctica. Ethiopia. Malaya. Oceania.

2. SCIRPUS SUBMERSUS, *C. Wright*; *Hook. f. l. c.* vi. 653.

[Though published in Sauvalle, I believe this species to be wholly of C. Wright.]

**4.** Ceylon, *Thwaites*, 3936; Colombo, *Beckett*, 2495 (hb. Calcutta).

*Distrib.* Madagascar. Java. Carolina. Neotropica.

3. SCIRPUS PAUCIFLORUS, *Lightf.*; *Hook. f. l. c.* vi. 654.

**1.** Kashmir, 8500 feet, *C. B. Clarke*, 29523. Piti, *T. Thomson*.

*Distrib.* Palæarctica. Nearctica.

SCIRPUS PUMILUS, *Vahl*; *Hook. f. l. c.* vi. 654.

**1.** Kashmir: Gilgit, *Giles*, 64; Skardo and Hanle, 15,000 feet, *T. Thomson*; Gurais, *Winterbottom*, 551.

*Distrib.* Palæarctica. Nearctica.

5. SCIRPUS SETACEUS, *Linn.*; *Hook. f. l. c.* vi. 654.

**1.** Kashmir, *Jacquemont*, 477, 1726, 1909, *Falconer*, 1159; Gulmurg, *Stewart*, 799, *Aitchison*, 157; Sonamurg, 11,000 feet, *C. B. Clarke*, 24206. Kurrum Valley, *Aitchison*, 965. West Tibet, 13,000 feet, *T. Thomson*; Skardo, 8000 feet, *C. B. Clarke*, 30028. Balti, *Schlagintweit*, 5867. Astor, *Schlagintweit*, 6414. Gurhwal, 9500 feet, *Duthie*, 76. Kunawur, *Jacquemont*, 1726, 1909. Kumaon, *Royle*, 63; 12,000 feet, *Duthie*, 7; 13,000 feet, *Strachey*, 1667. West Nepal, 1200 feet, *Duthie*, 3465.

**7.** Sikkim, 13,000 feet, *J. D. Hooker*.

*Distrib.* Palæarctica. Ethiopia. (A var. (?) in Australia.)

6. Scirpus Holoschœnus, *Linn.*; *Hook. f. Fl. Brit. Ind.* vi. 655.

**2.** Hazara, 5500 feet, *Stewart* (hb. Calcutta). Sind, *Pinwill.*

*Distrib.* Palæarctica (with a Var. in South Africa).

7. Scirpus supinus, *Linn.*; *Hook. f. l. c.* vi. 655.

**1.** West Himalaya, *Jacquemont*, 461, 743, *Royle*, 58, 71; Kangra, 3000 feet, *C. B. Clarke*, 23779.

**2.** Sind, *Pinwill.*

**3.** Bombay, *Dalzell.* Concan, *Law.*

**4.** Ceylon, *Thwaites*, 3233.

**5.** Tranquebar, *Rottler*, 216. Madras Peninsula, *Wight*, 1889 *b*, 2893 (hb. Calcutta), *Wallich*, 3461 A, B, C (hb. propr.), 3493 (hb. Calcutta), 3458 part. (hb. Delessert). Central India: Chunda, *Duthie*, 9826, 9827, 9838. Chota Nagpore, *Gamble*, 8730; 9041, 1000–2000 feet, common, *C. B. Clarke*.

**6.** Gangetic Plain, *Wallich*, 3461. Hindoosthan, *Duthie*, 5017. Moradabad, *T. Thomson*, 352; Gajpoor, *Buchanan Hamilton*, 192. Purnea, *Buchanan Hamilton*, 193, *Wallich*, 3461 D (hb. propr.). Bengal, *Wallich*, 3461 E (hb. propr.), *Griffith*, Kew n. 6288 part., *J. D. Hooker*, 401, 609, common, *C. B. Clarke*. Calcutta, *Gaudichaud*, 124.

**8.** Sylhet, *Wallich*, 3468 (hb. Calcutta). Chittagong, *C. B. Clarke*, 6597.

**10.** Akyab, *Kurz*, 644. Mergui, *Griffith*, 292.

**11.** Penang and Malacca, fide *Ridley*.

*Distrib.* Palæarctica. Ethiopia. China. Malaya. Australia. [Var. in U.S.]

Scirpus supinus, *Linn.*:

Var. uninodis, *C. B. Clarke in Hook. f. l. c.* vi. 656.

**2.** Sind, *Pinwill.*

**4.** Ceylon, *Macrae*, 1052, *Leschenault.*

**5.** Coromandelia, *Roxburgh.* Madras Peninsula, *Wight*, 2893 (hb. Paris), 1889 (hb. Berlin). Goomsur, *Beddome.*

**6.** Bengal, *Wallich*, 3461 E (hb. DC., Mus. Brit.), *J. D. Hooker.*

*Distrib.* Ethiopia. Java. Queensland.

8. SCIRPUS ERECTUS, *Poir.*; *Hook. f. Fl. Brit. Ind.* vi. 656.

**1.** Kumaon, *T. Thomson*, 1239. Kunawar, *Jacquemont*, 1137, *T. Thomson*, 18; Kangra, 3000 feet, *C. B. Clarke*, 23783. Nepal, *Wallich*, 3469 C (hb. propr.).

**3.** Nilgiri Mts., *G. Thomson*.

**4.** Ceylon, *Moon*, 504; abundant, *Thwaites*, 850.

**5.** Madras Peninsula, *Wallich*, 3469 A, B (hb. propr.).

**6.** Saharunpore, *Royle*, 52. Bengal, *Wallich*, 3462, 3469 (hb. propr.), *Buchanan Hamilton*, 197, *Griffith*, Kew n. 6260 (hb. DC.), 6261, 6314 part., *J. D. Hooker*, 305, common, *C. B. Clarke*.

**7.** Sikkim, Darjeeling, *Griffith*, Kew n. 6260; Lachen, 8000 feet, *J. D. Hooker*.

**8.** Assam, *Griffith*, 1485, 1591, *Schlagintweit*, 13479, *Masters*, 215. Khasi Hills, 7500-6000 feet, common, *C. B. Clarke*. Cachar, *C. B. Clarke*, 18546. Sylhet, *Wallich*, 3468 (hb. propr., DC.), 3469 D (hb. propr.). Chittagong Hills, *Gamble*, 7951.

**9.** Ava, *Wallich*, 4471; Bhamo, *Griffith*, *J. Anderson*.

**10.** Pegu, *Scott*, 432. Arracan, *Kurz*, 645. Mergui, *Griffith*, 292, Kew n. 6288 part.

**11.** Perak, *Kunstler*, 1948. Perak and Malacca, fide *Ridley*.

*Distrib.* Orient. Mascarenia. Indo-China. Australia. Timor. Canada. U.S. Orient.

9. SCIRPUS ARTICULATUS, *Linn.*; *Hook. f. l. c.* vi. 656.

**1.** Kumaon and Nepal, *Wallich*, 3457 E, H (hb. propr.).

**2.** Sind, *Pinwill*. Marwar, *King*.

**3.** Bombay, *Law*. Canara, *Law*.

**4.** Ceylon, common, *Thwaites*, 846.

**5.** Coromandelia, *Bélanger*, 200, 201. Madras Peninsula, *Wallich*, 3457 A, B (hb. propr.), *Wight*, 1890, 1891 (hb. Kew), 62, 63 (hb. Berlin), 2889 (hb. Calcutta). Mysore, *G. Thomson*. Jubbulpore, *Kuntze*, 75. Chunda, *Duthie*, 9853. Chota Nagpore, *Gamble*, 9075; 500–1500 feet, frequent, *C. B. Clarke*.

**6.** Hindoosthan, *Royle*, 151. Oudh, *R. Thompson*. North Behar, *Wallich*, 3457 C, D (hb. propr.). Bengal, *Buchanan Hamilton*, 199, 200, *Griffith*, Kew n. 6284, 6285, *J. D. Hooker*, 40, 611; common, *C. B. Clarke*.

**8.** Sylhet, *Wallich*, 3457 F (hb. propr.). Chittagong, *Kurz*.

**9.** Segain, *Wallich*, 3457 G (hb. propr.).

**10.** Moulmein, *Wallich*, 3456 (hb. propr.).

*Distrib.* Mediterranea. Ethiopia. Philippines. Australia.

10. SCIRPUS QUINQUEFARIUS, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 657.

**1.** Kunaor, *Jacquemont*. Choor, *Royle*, 31 (hb. propr.). Rawul Pindee, *Aitchison*, 259.

**2.** Punjab, *T. Thomson*. Sind, *Pinwill*. Cutch, *Stoliczka*. Marwar, *King*.

**3.** Goojerat, *Hove*. Poona, *Cooke*.

**5.** Central India, *King*, 44.

**6.** Saharunpore, *Royle*, 9, 48 (hb. propr.). Lucknow, *T. Anderson*, 663. Aligurh, *Duthie*, 4917 *a*. Furruckabad, *Buchanan Hamilton*, 198. Bengal: Raneegunj, *T. Anderson*, 12; Nawabgunj, *Wallich*, 3465 (hb. propr.); Beauleah, *C. B. Clarke*, 31862.

**8.** Assam, *Wallich & Griffith* (hb. Calcutta).

*Distrib.* Cabul. Turkestan. Ethiopia.

11. SCIRPUS MUCRONATUS, *Linn.*; *Hook. f. l. c.* vi. 657.

**1.** Kashmir, *Jacquemont*, 667, 1133, 2294, *C. B. Clarke*, 24202; Chumba, 3000 feet, *C. B. Clarke*, 24307; Kishtwar, *Schlagintweit*, 5115; Rawul Pindee, *Aitchison*, 559. Gurhwal, 6000 feet, *Duthie*, 70, 5007. Kumaon, *Jacquemont*, 1133, 2294; Baignath, *Strachey & Winterbottom*, 1914, *Royle*, 52. Nepal, *Wallich*, 3467 (hb. propr., Calcutta).

**2.** Punjab, *Stewart*, 790; R. Chenab, *T. Thomson*.

**3.** Concan, *Law*. Canara, *Talbot*, 588. Sirumallays, *Beddome*. Nilgiri Mts., *Hohenacker*, 947, *Schmidt*, *Perrottet*, 674, 6500 feet, *Gamble*, 12131, 7500 feet, *King*, *C. B. Clarke*, 10939.

**4.** Ceylon, *Macrae*, 195, 256; very common, *Thwaites*, 41.

**5.** Madras Peninsula, *Wight*, 2885, 2050 (hb. Delessert), *Wallich*, 3467 A (hb. propr.). Saugor, *Vicary*; Goona, *King*. Chota Nagpore, 2000 feet, common, *C. B. Clarke*.

**6.** Moradabad, *T. Thomson*, 192. Oudh, *R. Thompson*. Goruckpore, *Buchanan Hamilton*, 202. Monghyr, *Wallich*, 3467 E (hb. propr.). Bengal, *Wallich*, 3467 B, C (hb. propr., DC. Calcutta), *Griffith*, Kew n. 6260 part, 6258 (hb. Boissier).

**7.** Sikkim, 8000 feet, *King*; Lachen, 9000 feet, *J. D. Hooker*; Yoksun, 6000 feet, *C. B. Clarke*, 25404, 1750 feet, *C. B. Clarke*, 9442.

**8.** Assam, *Griffith*, 1489; Kamroop, *Buchanan Hamilton*, 201; Seebsagur, *C. B. Clarke*, 38064; Luckimpoor, *C. B. Clarke*, 37853. Khasia, *Hooker f. & T. Thomson*, 4000–5500 feet, frequent, *C. B. Clarke*. Sylhet, *Wallich*, 3467 F (hb. propr.).

**10.** Burma, *Griffith*, Kew n. 6258. Martaban, *Kurz*, 642.

**11.** Malacca, *Griffith*, Kew n. 6258. Singapore, *Kurz*, 2996, *Hallett*, 239, *Ridley*, 1723, *Wichura*, 691 (umbellâ 1-radiatâ).

*Distrib.* Europe. Mediterranea. Mascarenia. Indo-Malaya. Oceania.

12. SCIRPUS CORYMBOSUS, *Roth*; *Hook. Fl. Brit. Ind.* vi. 657.

**2.** Sind, *Pinwill*. Mt. Aboo, *King*.

**5.** Madras Peninsula, *Wallich*, 3471 (hb. propr.), *Wight*, 2376; Bangalore, *Wallich*, 3464 (hb. propr.); Hyderabad, *Campbell*. Jubbulpore, *Beddome*. Goonah, *King*.

**6.** Patna, *Buchanan Hamilton*, 191, *Wallich*, 3472 (hb. propr.).

*Distrib.* Egypt. Ethiopia.

13. SCIRPUS TRIQUETER, *Linn.*; *Hook. f. l. c.* vi. 658.

**1.** Kashmir, *Jacquemont*, 667; 6000 feet, *T. Thomson*, *W. S. Atkinson*. Baltisthan, *Schlagintweit*, 5421; 8500 feet, *C. B. Clarke*, 29957, 30023, 30487.

**2.** Sind, *Pinwill*.

*Distrib.* Palæarctica. Cape. China. Japan.

SCIRPUS TRIQUETER, *Linn.*:

Var. SEGREGATA, *C. B. Clarke*; *Hook. f. l. c.* vi. 658.

**6.** Lower Bengal, Soondreebun, *C. B. Clarke*, 16941, 16959, 16966, 33402, 33403, 33448, 33519, *Wallich*, 795 (hb. Mus. Brit.).

*Distrib.* New Guinea.

14. SCIRPUS LACUSTRIS, *Linn.*; *C. B. Clarke in Hook. f. l. c.* vi. 658.

**1.** Kashmir, *Stewart*, 789, 7500 feet, *C. B. Clarke*, 29070· Ladak, *Schlagintweit*, 1631. Kurrum Valley, *Aitchison*, 312, 465, 689. Kumaon, *T. Thomson*, 686. Bheem Tal, 6000 feet, *Strachey & Winterbottom*, 3.

**9.** Muneypoor, *Watt*, 7412.

*Distrib.* Palæarctica. Ethiopia. Japan. Oceania. Nearctica. Central America.

15. SCIRPUS MARITIMUS, *Linn.*; *Hook. f. Fl. Brit. Ind.* vi. 658.

**1.** West Himalaya, *Royle*, 99 (herb. Berlin). Kashmir, *Jacquemont*, 95, 357.

**2.** Punjab, *T. Thomson*, *Stewart*, 86, 298, 391. Sind, *Dalzell*; Merwar, *Duthie*, 4918. Neemuch, *Jacquemont*, 98.

**3.** Malabaria, *Law*.

**5.** Madras Peninsula, *Wight*, 1897, 2897 (hb. Boissier), 1527 (hb. Berlin), *Rottler*. Mysore, *Heyne*. Kurnool, *Beddome*. Chunda, *Duthie*, 9852.

**6.** Moradabad, *T. Thomson*, 353. Goruckpore and Furruckabad, *Buchanan Hamilton*, 189, 190. Oudh, *Wallich*, 3504, 3505 (hb. propr., Kew). Lucknow, *T. Anderson*.

*Distrib.* Palæarctica. Ethiopia. China. Japan. (Varieties in Oceania, America.)

SCIRPUS MARITIMUS, *Linn.*:

Var. AFFINIS, *C. B. Clarke*; *Hook. f. l. c.* vi. 659.

**2.** Sind, *Stocks*, 82, *Pinwill*. Punjab, *T. Thomson*.

**3.** Bombay, *Law*. Nassik, *Cooke*, 4. Asseergurh, *Wallich*, 3463 B (hb. propr., Kew, DC.).

**5.** Khundwa, *Duthie*, 8450. Bundelkund, *Edgeworth*.

**6.** Saharunpore, *Royle*, 42 (hb. propr.), *Jacquemont*, 502. Oudh, *R. Thompson*, 359. Delhi, *Royle*, 65, 66 (hb. propr.). Monghyr, *Wallich*, 3463 A (hb. propr.), *Buchanan Hamilton*, 204. Beauleah, *J. D. Hooker*. Pubna, *C. B. Clarke*, 8352. Moorshedabad, *C. B. Clarke*, 26203, 26258. R. Pudma, common, *C. B. Clarke*.

**7.** Sikkim, Tonglo, alt. 10,000–12,000 feet, *Schlagintweit*, 14721 (I think erroneous, C.B.C.).

**8.** Assam, *Griffith*, 1475. East Bengal, *Griffith*, Kew n. 6263.

**10.** Pegu, *Kurz*, 2710. Burma, *Scott*.

*Distrib.* Mongolia, Chefoo.

16. SCIRPUS LITTORALIS, *Schrad.*; *Hook. f. l. c.* vi. 659.

**1.** Kashmir, Rajaori, 3300 feet, *C. B. Clarke*, 28198.

**2.** Sind, *Dalzell*. Punjab, *Clarke*, 14. Hazara, *Stewart*, 85. Dehra Ismail Khan, *hb. Duthie*, 7214. Campbelpoor, *Stewart*, 31, 82. Loodiana, *T. Thomson*, 1603. Marwar, *King*, *Duthie*, 4918.

**3.** Bombay, *Dymock*; Bhiwa, *Cooke*; Canara, *Metz*. Yenamallays, *Gamble*, 17740.

**4.** Colombo, *Thwaites*, 831.

**5.** Madras Peninsula, *Wight*, 1895, 71 (hb. Berlin), 2897 (hb. Berlin), *Wallich*, 3506 B. Saugor, *Vicary*. Khundwa, *Duthie*, 8455. Chunda, *Duthie*, 9845. Bundelkund, *Edgeworth*.

**6.** Saharunpore, *Royle*, 56. Calcutta, *Kurz*, *C. B. Clarke*, 11578.

**10.** Nicobar Islands, fide *Miquel*.

*Distrib.* Palæarctica. Ethiopia. Oceania.

17. SCIRPUS GROSSUS, *Linn.*; *Hook. f. Fl. Brit. Ind.* vi. 659.

**2.** Sind, *Pinwill*; Mooltan, *Edgeworth*.

**3.** Malabaria, *Law*; Canara, *Bélanger*, 212.

**4.** Ceylon, *Walker*, *Fraser*, 108, *Thwaites*, 847.

**5.** Coromandelia, *Bélanger*, 210, 211. Pondicherry, *Perrottet*, 523. Madras Peninsula, *Wight*, 69 (hb. Berlin), *Wallich*, 3470 A, C (hb. propr.). Saugor, *Vicary*. Chunda, *Duthie*, 9871. Chota Nagpore, 2000 feet, *C. B. Clarke*, 25196.

**6.** Bengal Plain, *Griffith*, Kew n. 6268, *Wallich*, 3470 (hb. propr.), *J. D. Hooker*; common, *C. B. Clarke*.

**7.** Nepal, *Wallich*, 3470 D (hb. propr., Calcutta).

**8.** Assam, *Buchanan Hamilton*, 172. Gowhatty, *Simons*, 190.

**9.** Muneypoor, 2500 feet, *C. B. Clarke*, 42104.

**10.** Burma, *Griffith*, Kew n. 6269, *Falconer*, 1179. Mergui, *Griffith*, 382, Kew n. 6268. Moulmein, *O. Kuntze*, 6258.

**11.** Malay Peninsula, hb. *King*, 392. Penang, *Curtis*, 350. Malacca, *Griffith*, Kew n. 6270, *Lemann*.

*Distrib.* Malaya.

SCIRPUS GROSSUS, *Linn.*:

Var. KYSOOR, *C. B. Clarke in Hook. f. l. c.* vi. 660.

**3.** Bombay, *Dalzell*, *Cooke*.

**5.** Chota Nagpore, 2000 feet, *C. B. Clarke*, 34210, 34211, 34329.

**6.** Purnea, *Buchanan Hamilton*, 173. Bengal Plain, *Wallich*, 586 (hb. Mus. Brit), *Griffith*, *J. D. Hooker*, *C. B. Clarke*, 14225, 26809, 26826, 34485.

**8.** Upper Assam, *Jenkins*, 214.

*Distrib.* Endemic.

18. Scirpus Caricis, *Retz.*; *Hook. f. Fl. Brit. Ind.* vi. 660.

**1.** Kashmir, 8000–12,000 feet, frequent, *C. B. Clarke*. Tibet, 16,000 feet, *Strachey & Winterbottom*. Leh, 13,000 feet, *Stoliczka*. Dras, *Schlagintweit*, 6467, 6670. Kumaon, 9000–12,000 feet, *Schlagintweit*, 7064, *Duthie*, 6067, 6070. Kunawur, *Jacquemont*, 1356, 1852.

**7.** Pharee, hb. *G. King*.

*Distrib.* Palæarctica.

Scirpus Caricis, *Retz.*:

Var. β. brevifolia, *C. B. Clarke in Hook. f. l. c.* vi. 660.

**1.** Chini, *Jacquemont*, 1332. Tibet, *Jacquemont*, 1852, 10,000–14,000 feet, *Stoliczka*.

*Distrib.* Endemic.

Scirpus Caricis, *Retz.*:

Var. γ sikkimensis, *C. B. Clarke in Hook. f. l. c.* vi. 661.

**7.** Sikkim, Lachen, 9000 feet, *J. D. Hooker*.

*Distrib.* Endemic.

Scirpus Caricis, *Retz.*:

Var. δ. dissita, *C. B. Clarke in Hook. f. l. c.* vi. 661.

**1.** Kumaon, Kutti, 13,500 feet, *Duthie*, 3460.

*Distrib.* Turkestan.

19. Scirpus rufus, *Schrad.*; *Hook. f. l. c.* vi. 661.

**1.** West Tibet, *T. Thomson*.

*Distrib.* Cooler Europe. Mongolia. Canada. Chile.

20. Scirpus subcapitatus, *Thwaites*; *Hook. f. l. c.* vi. 661.

**3.** Nilgiri Mts., *Gardner*.

**4.** Newera Elia, *Thwaites*, 306. Blackpool, *T. Anderson*.

**5.** Madras Peninsula, *Wight*, 2913.

*Distrib.* China. Sumatra. Borneo.

21. Scirpus Eriophorum, *Mich.*; *Hook. f. l. c.* vi. 661.

**7.** East Himalaya, *Griffith*, 249, 765, Kew n. 6266.

**8.** Assam, *Jenkins*. Khasia, 2500–6000 feet, *Voigt*, *J. D. Hooker*, 1450, *G. Mann*, 336, 383, common, *C. B. Clarke*.

*Distrib.* China. Japan. Nearctica. Mexico.

22. Scirpus ternatensis, *Miq. Fl. Ind. Bat.* iii. [1855] 307. [*i. e.* S. chinensis, *Munro* [1857]; *Hook. f. Fl. Brit. Ind.* vi. 662.]

**1.** Chumba, hb. *Calcutta*; Kumaon, 5600 feet, *Strachey & Winterbottom*, 2. Pattudoon, *Brandis* (hb. Saharunpore).

**7.** Sikkim, Lachen, 6000 feet, *J. D. Hooker*. Sikkim, 1000–4000 feet, *T. Anderson*, 262, *King*, *Kurz*, *C. B. Clarke*, 11995, 27651. Bhotan, *Griffith*, 841, 2669, Kew n. 6265.

**8.** Assam, *Jenkins*. Gowhatty, *J. D. Hooker*, *Simons*. Khasia, 4500 feet, *J. D. Hooker*. Cachar, *Keenan*. Chittagong Hills, *Gamble*, 7848.

**9.** Muneypoor, 5000 feet, *Watt*, 6768, 7115.

**10.** Burma, *Griffith*, Kew n. 6265. Martaban, *Wallich*, 3404 A, F (hb. Kew), 3404 F (hb. Calcutta).

*Distrib.* China. Malaya.

23. Scirpus kyllingioides, *Boeck.*; *Hook. f. l. c.* vi. 662.

**1.** Dhoon, *Vicary*.

**2.** Mt. Aboo, 300 feet, *King*.

**3.** Canara, *Young*.

**5.** Hydrabad, *Campbell*. Saugor, *Vicary*. Goona, *King*.

*Distrib.* Tropical Africa.

24. Scirpus Michelianus, *Linn.*; *Hook. f. l. c.* vi. 662.

**1.** Kashmir, *T. Thomson*.

**3.** Bombay, *Cooke*.

**5.** Chunda, *Duthie*, 9842. Khandwa, *Duthie*, 8459.

**6.** Delhi, *Royle*, 92. Etawah, *Duthie*. Bengal, *Wallich*, 3484 A, C part (hb. propr.), *J. D. Hooker*; common, *C. B. Clarke*, 8158, 26174, 26193, 26278, 26279.

**8.** Assam, *Buchanan Hamilton*, 205, *Masters*, 204, *Griffith*, 1611 (Mus. Brit.). Silhet, *Wallich*, 3484 B.

**9.** Ava, *Wallich*, 3495. Bhamo, *J. Anderson*.

**10.** Pegu, *Scott*, 399. Burma, *Griffith*, Kew n. 6185 part. Tenasserim, *Gallatly*, 631.

*Distrib.* Palæarctica. Indo-China.

25. Scirpus Isolepis, *Boeck.*; *Hook. f. l. c.* vi. 663.

**5.** Madras Peninsula, *Wight*, 1856 (68 hb. Berlin). Chota Nagpore, 2000 feet, *C. B. Clarke*, 34190.

**6.** Behar, *J. D. Hooker*, 177. Bengal, *Griffith*.

*Distrib.* Ethiopia.

26. SCIRPUS SQUARROSUS, *Linn.*; *Hook. f. Fl. Brit. Ind.* vi. 663.
  **1.** Gurhwal, 6000 feet, *Duthie*, 5018. Dehra Dhoon, *Duthie*, 7659.
  **2.** Punjab, *T. Thomson.* Sind, *Pinwill.*
  **4.** Ceylon, *Thwaites*, 854. North Ceylon, *Gardner*; Colombo, *Beckett.*
  **5.** Madras Peninsula, *Rottler*, *Wallich*, 3477 part, 3478, *Wight*, 1888, 1888 *b* (hb. propr.), 67, 67 B, 68 C (hb. Berlin). Hydrabad, *Campbell.* Central India: Goona, *King*; Khandwa, *Duthie*, 8451; Chunda, *Duthie*, 9849. Chota Nagpore, 1000–2000 feet, *C. B. Clarke*, 21095, 21139, 21178, 24792, 25035, 33889.
  **6.** Gangetic Plain, *Wallich*, 3477, 3478 B (hb. propr.), 1137. Monghyr, *Buchanan Hamilton*, 194, 196. Bengal, common, *C. B. Clarke*, 3710, 7593, 8032, 20151, 33603.
  **7.** Sikkim Terai, *C. B. Clarke.*
  **8.** Assam, *Wallich & Griffith.* East Bengal, *Griffith*, Kew n. 6287 part.
  **10.** Moulmein, *Helfer*, 249 (hb. DC.).
*Distrib.* Ethiopia. China. Java.

1. ERIOPHORUM SCHEUCHZERI, *Hoppe*; *Hook. f. l. c.* vi. 664.
  **1.** Kashmir, *Lance*, 287; 13,500 feet, *C. B. Clarke*, 30674.
*Distrib.* Palæarctica. Japan. Nearctica.

2. ERIOPHORUM COMOSUM, *Wallich*; *Hook. f. l. c.* vi. 664.
  **1.** West Himalaya, *Royle*, 79, 80 (hb. propr.). Kashmir: Jhelum Valley, *Griffith*, Kew n. 6283, *C. B. Clarke*, 27353; Budrawur, 6500 feet, *Stoliczka*; Bhimbur, 3000 feet, *Stewart*, 785; Kishtwar, 4000 feet, *C. B. Clarke*, 31439; Rajaori, *Jacquemont*, 1357, 6500 feet, *Schlagintweit*, 12210; Chungas, 2500 feet, *C. B. Clarke*, 28200; Sreenuggur, *Schlagintweit*, 4600; Chumba, 4000 feet, *C. B. Clarke*, 23754; Jamu, *T. Thomson*; Dalhousie, 6000 feet, *C. B. Clarke*, 22102, 22770. Mussooree, *Royle*, 148 (hb. propr.), *G. King*, 3000–5000 feet, *Brandis*, 2998, 3323. Kumaon, 3000–5000 feet, *Strachey & Winterbottom*, 1, 2. Almora, 6000 feet, *Madden.* Simla, *Madden*; 6000 feet, *Gamble*, 4859. Kulu, *Schalch.* Kaleedongee, *T. Thomson*, 866. Gurhwal, 5000 feet,

*Duthie*, 2108. Dehra Dhoon, *King*, *Vicary*, *Jacquemont*, 322. Nepal, *Wallich*, 3446, 3447 (hb. propr.).

**2.** Hazara, 3300 feet, *Stewart*, *Falconer*, 1137. Hurroo, 3300 feet, *Stewart*, 290. Campbelpore, *Stewart*. Peshawur, *Schlagintweit*, 2588. Pathankote, 1500 feet, *C. B. Clarke*, 21971. Punjab, *Aitchison*, 316. Jullundur, 1000 feet, *C. B. Clarke*, 23350. Sind, *Pinwill*. Asseerghur, *Hobson*.

**5.** Saugor, *Vicary*; Goona, *King*; Khandwa, *Duthie*, 8449.

**7.** East Himalaya, *Griffith*, Kew n. 6282 part. Nepal, *Buchanan Hamilton*; R. Tambur, *J. D. Hooker*. Sikkim, 500–2000 feet, *J. D. Hooker*, *King*, 2415; Titaliya, *Kurz*; Sivoke, *Gamble*, 3178; Choonbuttee, 3000 feet, *C. B. Clarke*, 26511. Bhotan, *Griffith*, 6283.

**8.** Assam, *Simons*, *Fielding*. Brahmakoondo, *Griffith* Chittagong, *J. D. Hooker*, 589.

**9.** Paghamew, *Wallich*, 3448 A.

**11.** Penang, *Wallich*, 3448 A.

*Distrib.* China. Tonkin.

3. ERIOPHORUM MICROSTACHYUM, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 664.

**1.** West Himalaya, *Royle*, 78. Chinese Tartary, 16,000 feet, hb. *Munro*. Jumna Source, *Jacquemont*, 762. Nynee Tal, *T. Thomson*, 646.

**7.** Bhotan, Chupcha, 8000 feet, *Griffith*, 2668, Kew n. 6282 part.

*Distrib.* Endemic.

1. FUIRENA PUBESCENS, *Kunth*; *Hook. f. l. c.* vi. 665.

**2.** Punjab, *T. Thomson* (hb. Mus. Brit., C. Melville).

*Distrib.* Mediterranea. Ethiopia.

2. FUIRENA WALLICHIANA, *Kunth*; *Hook. f. l. c.* vi. 665.

**1.** Hurdwar, *Wallich*, 3545. Sutledge Valley, *T. Thomson*, 1798.

**3.** Bombay, *Lambert*, *Dalzell*; Bhiwa, *Cooke*; Poona, *Jacquemont*, 413.

**5.** Central India, *King*, 18, 51; Goona, *King*, 47; Khandwa, *Duthie*, 8454.

*Distrib.* Endemic.

FUIRENA WALLICHIANA, *Kunth*:

Var. EVOLUTA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 666.

**2.** Marwar, *Duthie*, 4919 (hb. Kew).

*Distrib.* Endemic.

3. FUIRENA GLOMERATA, *Lam.*; *Hook. f. l. c.* vi. 666.

**1.** West Himalaya, *Royle*, 75 (hb. propr.).

**3.** Concan, *Law.* Canara, *Hohenacker*, 194, *Talbot*, 779, 1032, *Young*.

**4.** Ceylon, *Thwaites*, 2748, *Fraser*, 72.

**5.** Madras Peninsula, *Koenig*, *Wight*, 1862, 2886 (hb. Berlin), *Wallich*, 3544 A part, B, C (hb. propr.), *Bélanger*, 181, 182. Mysore, *Rottler*. Cuddapore, *Beddome*. Central India, *Vicary*, 188; Chunda, *Duthie*, 9857. Chota Nagpore, *V. Ball*, 1000–2000 feet, common, *C. B. Clarke*.

**6.** Behar, *J. D. Hooker*, 425. Burdwan, *C. B. Clarke*, 25287. Mymensingh, *C. B. Clarke*, 8094. Beauleah, *C. B. Clarke*, 31870. Burisal, *C. B. Clarke*, 8185.

**8.** Assam, *Masters*. Noakhali, *J. D. Hooker*, 91, *C. B. Clarke*, 8197. Chittagong, *Hooker f. & T. Thomson*.

**10.** Akyab, *Kurz*, 622. Burma, *Griffith*, 316, Kew n. 6280. Prome, *Wallich*, 3544 B, C. Rangoon, *Kurz*, 2712. Mergui, *Griffith*, 317, Kew n. 6280, *Griffith*, 289, Kew n. 6278. Tavoy, *Wallich*, *Parish*, 154.

**11.** Perak, *Kunstler*, 2451. Malacca & Singapore, *fide Ridley*.

*Distrib.* Ethiopia. Indo-China. Oceania.

4. FUIRENA UNCINATA, *Kunth*; *Hook. f. l. c.* vi. 666.

**3.** Canara, *Dr. Thomson*. Nilgiri Mts. and Kurg, *G. Thomson*, 126.

**4.** Ceylon, *Moon*, *Walker*, *Macrae*, 279; very abundant, *Thwaites*, 3038.

**5.** Madras Peninsula, *Wallich*, 3544 A part, D (hb. propr.), *Rottler*, *Koenig*, *Bélanger*, 192, *Wight*, 1860 (hb. propr.).

*Distrib.* Endemic.

5. FUIRENA TRILOBITES, *C. B. Clarke in Hook. f. l. c.* vi. 666.

**5.** Secunderabad, *Wight*, 216 (hb. propr.). Hyderabad, *Campbell* (hb. Mus. Brit.).

*Distrib.* Endemic. [It is not improbable that Wight got his example from Campbell; and that this species has been only once collected.]

6. FUIRENA UMBELLATA, *Rottb.*; *Hook. f. Fl. Brit. Ind.* vi. 666.
   4. Ceylon, *Macrae*, 206, 271; common, *Thwaites*, 3229, 3230.
   5. Madras Peninsula, *Wight*, 1861, 2384 (2888, 2910 hb. Calcutta), *Wallich*, 3543 (hb. propr.), *Bélanger*, 183. Tranquebar, *Rottler*. Cuddapore, *Beddome*. Central India, Chunda, *Duthie*, 9856.
   6. Dinajpore, *C. B. Clarke*, 26441. Mymensingh, *C. B. Clarke*, 7783.
   7. Sikkim Terai, *J. D. Hooker*, *C. B. Clarke*, 36972, 37037.
   8. Assam, *Griffith*, 1484, 1613, *Jenkins*, *Simons*. Khasi Hills, *Mann*, 344; 3000 feet, *C. B. Clarke*, 38127. Sillet, *Wallich*, 3542 (hb. propr.). Chittagong, *J. D. Hooker*, 224.
   9. Muneypoor, 1000 feet, *Watt*, 6633.
   10. Pegu, *Kurz*, 2711. Arracan, *Kurz*. Burma, *Griffith*, Kew n. 6276. Mergui, *Griffith*, 447, Kew n. 6279. Tenasserim, *Packman*, *Helfer*, Kew n. 6277. Nicobars, *Kurz*, 25986.
   11. Penang, *King*. Malacca, *Griffith*. Singapore, *Lobb*, *T. Anderson*, 205, *Ploem*, 518, *Wichura*, 696.

*Distrib.* Ethiopia. Indo-China. Oceania. Neotropica.

1. LIPOCARPHA ARGENTEA, *R. Br.*; *Hook. f. l. c.* vi. 667.
   1. Dhurmsala, 4000 feet, *C. B. Clarke*, 24697; Dehra Dhoon, *Vicary*, *Duthie*, 2400. Almora, 5000 feet, *Strachey & Winterbottom*. Kumaon, *Wallich*, 3445 G (hb. propr.), *King*, 3300 feet, *Duthie*, 2, 3464. Gurhwal, 6000 feet, *Duthie*, 5015. Nepal, *Wallich*, 3445 F (hb. propr.).
   3. Nilgiri Mts., *Hohenacker*, 949; Pykara and Ooty, *King*; Ooty, 8000 feet, *Gamble*, 12483. Canoor, 7000 feet, *C. B. Clarke*, 10925.
   4. Ceylon, *Koenig*, *Moon*, *Gardner*, 967; 0–3000 feet, common, *Thwaites*, 819.
   5. Madras Peninsula, *Wight*, 218, 2907. Chota Nagpore, 2000 feet, *C. B. Clarke*, 21216.
   7. Sikkim, *J. D. Hooker*, *Kurz*. Darjeeling, *Griffith*, Kew n. 6297. Rungait, 1500 feet, *C. B. Clarke*, 9440. Dulkajhar, 500 feet, *C. B. Clarke*, 36913.
   8. Assam, *Simons*, *Jenkins*, 217. Khasia, 0–4500 feet, *Wallich & Griffith*, *Hooker f. & T. Thomson*, *Oldham*,

*Mann*, 231, *Griffith*, Kew n. 6297, *C. B. Clarke*, 5127, 14560, 15730, 18864, 38410, 44352, 45859. Cachar, *Keenan*. Sillet, *Wallich*, 3445 H (hb. propr.), *C. B. Clarke*, 7161. Pundua, *J. D. Hooker*, 357. Chittagong, *Lister*.

**9.** Muneypoor, 4000 feet, *Watt*, 7156.

**11.** Penang, *King*. Singapore, *Kurz*, 3020, *Kunstler*, 109, *Wichura*, 692, *Ridley*, 58.

***Distrib.*** Ethiopia. Indo-Malaya. Queensland.

2. LIPOCARPHA TRICEPS, *Nees in Wight Contrib.* [1834] 92.
[*i. e.* Lipocarpha sphacelata, *Kunth* (1837); *Hook. f. Fl. Brit. Ind.* vi. 667.]

**4.** Doombera District, *Thwaites*, 3756.

**5.** Coromandelia, *Bélanger*, 193. Courtallum, *Wight*, 2906. Madras Peninsula, *Wallich*, 3402 B, 3444 A, C (hb. propr.), *Wight*, 1857, 1858. Tranquebar, *Rottler*. Saugor, *Vicary*. Chunda, *Duthie*, 9874. Chota Nagpore, 750–2000 feet, common, *C. B. Clarke*.

**6.** West Bengal, *Roxburgh*, *Kurz*. Burdwan, 500 feet, *C. B. Clarke*.

**7.** Nepal, *Wallich*, 323 (hb. Berlin).

**8.** Assam, *Masters*, 218. East Bengal, *Griffith*, Kew n. 6297 in hb. DC.

**10.** Pegu, *Kurz*, 605, 635. Prome, *Wallich*, 3444 B (hb. propr.).

***Distrib.*** Trop. Africa. Neotropica.

3. LIPOCARPHA MICROCEPHALA, *Kunth*; *Hook. f. l. c.* vi. 668.

**11.** Singapore, *Ridley*, 1722.

***Distrib.*** China. Japan. Oceania.

1. RYNCHOSPORA WALLICHIANA, *C. B. Clarke in Hook. f. l. c.* vi. 668.

**3.** Malabaria, *Wight*, 2911 (hb. Berlin).

**4.** Ceylon, *Wallich*, 3428 (hb. propr.), *Macrae*, 117; common up to 4000 feet, *Thwaites*, 2746.

**5.** Madras Peninsula, *Wight*, 1903 part (hb. propr.).

**6.** Bengal, *Wallich*, 3421. Mymensingh, *C. B. Clarke*, 7777.

**7.** Nepal, *Wallich*, 3422 A part (hb. propr.). Sikkim Terai, *C. B. Clarke*, 36971. Cooch Behar, *Buchanan Hamilton*, 216.

**8.** Assam, *Masters*, 220. Kohima, 6500 feet, *C. B. Clarke*, 41390. Khasi Hills, 4000–5500 feet, *Griffith*, Kew n. 6301, *J. D. Hooker*, 1579; frequent, *C. B. Clarke.*

**10.** Pegu, *Kurz*, 621, 2700. Burma, *Wallich*, 3422. Mergui, *Griffith*, Kew n. 6301. Nicobars, *Kurz*, *Kamphoevener*, 2486.

**11.** Malacca, *Griffith.*

*Distrib.* Ethiopia. Indo-China. Oceania.

2. RYNCHOSPORA WIGHTIANA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 669.

**3.** Malabaria, *Stocks*, *Law.* Concan, *Dalzell.* Poona, *Jacquemont*, 649. Canara, *Metz*, 827, *Talbot*, 980. Cannanore, *Campbell* (hb. Wight, propr. n. 1903 part).

**4.** Ceylon, *Thwaites*, 2746 part (in hb. DC.).

**5.** Quilon, *Wight*, 2911 (hb. Kew). Central India, Chunda, *Duthie*, 9873.

*Distrib.* Cochin China. (A var.? in Brasil.)

3. RYNCHOSPORA LONGISETIS, *C. B. Clarke in Hook. f. l. c.* vi. 669.

**10.** Pegu, *Kurz*, 1100. Prome, *Wallich*, 3423. Karen Country, *Kurz.* Nummayan, *R. Scott.*

*Distrib.* North Australia.

4. RYNCHOSPORA MALASICA, *C. B. Clarke in Hook. f. l. c.* vi. 670.

**11.** Malacca, *Griffith*, Kew n. 6358. Singapore, *Ridley*, 80.

*Distrib.* Borneo.

5. RYNCHOSPORA AUREA, *Vahl*; *Hook. f. l. c.* vi. 670.

**3.** Malabaria, *Wight*, 109, 1285, 1904, 2912. Canara, *Talbot*, 1028, 1045.

**4.** Ceylon, *Burman*, 45. Colombo, *Rottler.* Caltura, *Macrae*, 232. Batangoda, *Thwaites*, 199.

**5.** Madras Peninsula, *Wallich*, 3371.

**7.** Sikkim Terai, *Kurz.*

**8.** Assam, *Simons*, 80, 291, 293, *Schlagintweit*, 13495, *Masters*, 222, *Jenkins*, 96; frequent, *C. B. Clarke.* Sylhet, *C. B. Clarke*, 7108, 17946, 17994. Chittagong, *J. D. Hooker*, 416, *C. B. Clarke*, 19511.

**10.** Pegu, *Griffith & Helfer*, Kew n. 6274, 6275. Rangoon, *Kurz*, 2699. Nicobars, *Kurz.*

**11.** Penang, *Wallich*, 3424, *Curtis*, 1256. Malacca, *Gaudichaud*, 93. Singapore, *Gaudichaud*, 119, *Kurz*, 3006, *Kunstler*, 131, *Wichura*, 697, *Jagor*, 32.

*Distrib.* Ethiopia. China. Malaya. Oceania. Neotropica.

6. RYNCHOSPORA TRIFLORA, *Vahl*; *Hook. f. Fl. Brit. Ind.* vi. 670.

**4.** Ceylon, *Macrae*, 252. Saffragam District, *Thwaites*, 3036.

*Distrib.* Cuba. North Brasil.

7. RYNCHOSPORA HOOKERI, *C. B. Clarke in Hook. f. l. c.* vi. 671.

**6.** North Bengal, Nathpur, *Wallich*, 3425. Mudhopoor, *C. B. Clarke*, 7700, 7780, 7788.

**7.** Cooch Behar, *Buchanan Hamilton*, 215.

**8.** Assam, *Jenkins*. Seebsagur, *C. B. Clarke*, 40748. Sylhet, Pundua, *J. D. Hooker*, 389.

**10.** Pegu, *Brandis* (hb. Calcutta).

*Distrib.* Endemic.

8. RYNCHOSPORA GRACILLIMA, *C. B. Clarke in Hook. f. l. c.* vi. 671.

**4.** South Ceylon, *Thwaites*, 3818.

**5.** Tinnevelly Hills, *Beddome*.

**8.** Khasia, *J. D. Hooker*.

**10.** Nicobars, *Kurz* (hb. Calcutta), *Kamphoevener*, 2483.

*Distrib.* Hongkong.

9. RYNCHOSPORA GLAUCA, *Vahl*; *Hook. f. l. c.* vi. 671.

**3.** Nilgiri Mts., 5000–6500 feet, *Hochstetter*, 1297, *Gamble*, 11883, 11884; frequent, *C. B. Clarke*. Pykara, *King*.

**4.** Ceylon, *Moon*, 455; 4000–6000 feet, abundant, *Thwaites*, 2396.

**5.** Madras Peninsula, *Wight*, 2904.

**7.** Nepal, *Wallich*, 3421.

**8.** Khasia, 4000–6400 feet, common, *C. B. Clarke*, 38349, 38497, 38800.

*Distrib.* Algeria. Ethiopia. Japan. Malaya. Australia. Neotropica.

RYNCHOSPORA GLAUCA, *Vahl*:

Var. CHINENSIS, *C. B. Clarke in Hook. f. l. c.* vi. 672.

**4**. Ceylon, *Gardner*, 951, *Macrae*, 144; south of the island, *Thwaites*, 677.

**10**. Tenasserim, *Helfer*, Kew n. 6303 (6279 in hb. Calcutta). Mergui, *Griffith*, 137, Kew n. 6302.

*Distrib.* Mascarenia. Indo-China. Sandwich.

10. Rynchospora Griffithii, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 672.

**8**. Assam, *Griffith*, 1588. East Bengal, *Griffith*, Kew n. 6303. Khasia, *J. D. Hooker* (hb. Kew); alt. 4200 feet, *C. B. Clarke*, 5206, 14656, 15818, 15824, 18928, 45790.

*Distrib.* Endemic in Assam.

Rynchospora Griffithii, *Boeck.*:

Var. leviseti s, *C. B. Clarke in Hook. f. l. c.* vi. 672.

**7**. Sikkim: Lachen, 10,000 feet, and Lachoong, 8500–11,000 feet, *J. D. Hooker.*

*Distrib.* Endemic in Sikkim.

11. Rynchospora sikkimensis, *C. B. Clarke in Hook. f. l. c.* vi. 672.

**7**. Sikkim: Lake Catsuperri, 7500 feet, *J. D. Hooker.*

*Distrib.* Endemic. (A single collection.)

1. Schœnus nigricans, *Linn.*; *Hook. f. l. c.* vi. 673.

**2**. Kurrum Valley, *Aitchison*, 358. Sind, *Pinwill.*

*Distrib.* Palæarctica. Cape. Nearctica.

2. Schœnus calostachyus, *Poir.*; *Hook. f. l. c.* vi. 673.

**11**. Singapore, *Ridley*, 1397, 1724.

*Distrib.* Borneo. Australia. Polynesia.

1. Cladium jamaicense, *Crantz, Instit.* i. [1766] 362. [*C. Mariscus*, R. Br.; Hook. f. l. c. vi. 673.]

**1**. Kashmir: City Lake, *Jacquemont*, 645, *Levinge*, *C. B. Clarke*, 27352, 29075.

*Distrib.* Palæarctica. Ethiopia. Indo-China. Oceania. East U.S. Neotropica.

2. Cladium Maingayi, *Ridley in Journ. Singapore Asiat. Soc.* n. 23 [1891] p. 16; *Hook. f. l. c.* vi. 674.

**11**. Mt. Ophir (near Malacca), near top, alt. 4000–4500 feet, *Griffith*, Kew n. 6304, *T. Lobb*, *Cuming*, 2379, *Maingay*, 1725, 2735, *Hullett*, 870, *Ridley*, 3140.

*Distrib.* North Celebes.

3. CLADIUM UNDULATUM, *Thwaites*; *Hook. f. Fl. Brit. Ind.* vi. 674.
**4**. Ceylon, *Rottler*, *Walker*, *Macrae*, 1059; South Ceylon, *Thwaites*, 3226.
**11**. Pahang, *Ridley*, 2.
*Distrib.* Sumatra. Borneo. North Australia.

4. CLADIUM RIPARIUM, *Benth.*:
Var. CRASSA, *C. B. Clarke in Hook. f. l. c.* vi. 675.
**4**. Ambagamowa District, *Thwaites*, 845.
**6**. Bengal: Soondreebun (Lower Burisal), *C. B. Clarke*, 16926.
**8**. Shillong (Station), alt. 5000 feet (in the lakes), *C. B. Clarke*, 16926.
*Distrib.* Endemic in India. (The typical *C. riparium* grows in South-west Australia.)

5. CLADIUM GLOMERATUM, *R. Br.*; *Hook. f. l. c.* vi. 675.
**11**. Singapore, *Ridley*.
*Distrib.* Hongkong. Nagasaki. Australia. New Zealand.

1. MICROSCHŒNUS DUTHIEI, *C. B. Clarke in Hook. f. l. c.* vi. 675.
**1**. Gurhwal, Tihri, alt. 15,500 feet, *Duthie*, 132.
*Distrib.* Endemic. (Only once collected.)

1. LEPIDOSPERMA CHINENSE, *Nees*; *Hook. f. l. c.* vi. 676.
**11**. Mt. Ophir (near Malacca), *Griffith*, Kew n. 6115, *Ridley*, 3127.
*Distrib.* China.

1. GAHNIA TRISTIS, *Nees in Linnæa*, ix. [1834] 301, *& in Hook. et Arn. Beechey Voy.* p. 228.
**11**. Singapore, *Kurz*, *Murton*, *Hullett*, 54, *Wichura*, 698, *Ridley*, 1723 *a*.
*Distrib.* China. Borneo.

2. GAHNIA JAVANICA, *Moritzi*:
Var. PENANGENSIS, *C. B. Clarke in Hook. f. l. c.* vi. 677.
**11**. Penang, 2500 feet, hb. *King*, 1750. Perak, 7000 feet, *Wray*, 887. Malacca, Punnus, 2500 feet, *Griffith*, Kew n. 6305; Mt. Ophir, 2000 feet, *Ridley*, 3142.
*Distrib.* Endemic. (The type *G. javanica* extends from Sumatra to the Philippines, Viti and New Caledonia.)

1. REMIREA MARITIMA, *Aubl.*; *Hook. f. Fl. Brit. Ind.* vi. 677.
  **3.** Canara, *Talbot*, 552.
  **4.** Ceylon, *Macrae*, 200; Jaffna, *Gardner*, *Thwaites*, 3227.
  **5.** Madras Peninsula, *Wight*, 1854, *Wallich*, 3378.
  **10.** Mergui, *Griffith*, 291, 298, 478. Tenasserim (vel Andamans), *Helfer*, Kew n. 6239. Nicobars, *Kurz*.
  **11.** Malacca, *Griffith*, *Maingay*, 3193.
  *Distrib.* Ethiopia. China. Malaya. Oceania. Neotropica.

1. HYPOLYTRUM LATIFOLIUM, *L. C. Rich.*; *Hook. f. l. c.* vi. 678.
  **4.** Ceylon, *Walker*, *Macrae*, 215, *Fraser*, 107; common up to 3000 feet, *Thwaites*, 219.
  **5.** Tranquebar, *Rottler*. Tinnivelly Hills, *Beddome*.
  **7.** Sikkim Terai, 500 feet, *C. B. Clarke*, 28064, 36802.
  **8.** Assam, *Jenkins*. East Bengal, *Griffith*, Kew n. 6272. Khasia: Theria, *J. D. Hooker*, 2142; Sobhar, 2000 feet, *C. B. Clarke*, 14327. Sillet, *Wallich*, 3404 part, *C. B. Clarke*, 7137, 8384, 8419, 17978. Chittagong: Seetakoond, *J. D. Hooker*, 384; Kasalong, *Gamble*, 7789.
  **10.** Pegu, *Griffith*, Kew n. 6271, *Kurz*, 2717. Moulmein, *Helfer*, 202, *Falconer*; Rangoon, *MacClelland*. Tavoy, Martaban, and Amherst, *Wallich*. Tenasserim, *Packman*. Andamans, *Kurz*. Nicobars, *Kurz*, *Jelinek*, 226. Mergui Archipelago, *Griffith*, 916, *J. Anderson*.
  **11.** Penang, *Wallich*, 3402, 3403, *Kunstler*, 1312, 1378. Perak, *Kunstler*. Groenong Panti, *Kunstler*, 228, *Wray*, 2040. Malacca, *Griffith*, Kew n. 6271, *Maingay*, 3188, 3189. Pahang, *Ridley*, 1219. Singapore, *T. Anderson*, 204, *Kurz*, *Kunstler*, 280.
  *Distrib.* China. Malaya. Queensland. Polynesia.

2. HYPOLYTRUM WIGHTIANUM, *Boeck.*; *Hook. f. l. c.* vi. 678.
  **3.** Canara, *Dalzell* (hb. Calcutta, Kew); Katgal, *Cooke*. Malabar (or Concan), *Stocks* (hb. Calcutta, Kew). Wynaad: Goodaloor, *King*, 1187 *a*, *b* (hb. Calcutta). Kuttru, hb. *Calcutta*, 868. Madras Peninsula, *Wight*, 1859 (hb. propr.).
  **10.** Nicobars, *Kurz* (hb. C. B. Clarke, 26010).
  *Distrib.* Endemic in Malabar and Nicobars.

3. HYPOLYTRUM TURGIDUM, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 679.

**4.** Central Province, 3000 feet, *Thwaites*, 3, *Beddome*.

***Distrib.*** Endemic.

4. HYPOLYTRUM PENANGENSE, *C. B. Clarke in Hook. f. l. c.* vi. 679.

**11.** Penang, *Maingay*, 2254 (hb. Kew, 1720).

***Distrib.*** Endemic.

5. HYPOLYTRUM TRINERVIUM, *Kunth*; *Hook. f. l. c.* vi. 679.

**11** ? East Indies, hb. *Willd.*, 1451 folio 1 (hb. Berlin).

***Distrib.*** Only this example known. It is of course a mere guess locating this in the Malay Peninsula.

6. HYPOLYTRUM PROLIFERUM, *Boeck.*; *Hook. f. l. c.* vi. 679.

**11.** Singapore, *Wichura*, 693, *Ridley*, 1716.

***Distrib.*** Borneo.

7. HYPOLYTRUM LONGIROSTRE, *Thwaites*; *Hook. f. l. c.* vi. 679.

**4.** Ceylon, *Beddome*; Hinidoon Corle, *Thwaites*, 3468.

***Distrib.*** Endemic.

1. THORACOSTACHYUM BANCANUM, *Kurz*; *Hook. f. l. c.* vi. 680.

**11.** Malacca, *Griffith*, Kew n. 6273, 6357. Pahang, *Ridley*, 1063, 1105. Singapore, *Wallich*, 340 (hb. propr.) part, 3404 (hb. propr.) part, *Gaudichaud*, 118, *Ridley*, 82, 124, 166, 168.

***Distrib.*** Bangka. Borneo.

THORACOSTACHYUM BANCANUM, *Kurz*:

Var. LONGISPICA, *C. B. Clarke in Hook. f. l. c.* vi. 680.

**11.** Malacca, *Griffith*, Kew n. 6357.

***Distrib.*** Endemic. (Only one collection.)

2. THORACOSTACHYUM HYPOLYTROIDES, *C. B. Clarke in Hook. f. l. c.* vi. 680.

**11.** Johore, *Ridley*, 4093.

***Distrib.*** Queensland. New Guinea.

1. MAPANIA SILHETENSIS, *C. B. Clarke in Hook. f. l. c.* vi. 681.

**8.** Assam, *Jenkins*; Luckimpore, 350 feet, *C. B. Clarke*, 37922. Sylhet, *Wallich*, 4474.

***Distrib.*** Endemic.

2. MAPANIA PALUSTRIS, *Benth.*; *Hook. f. Fl. Brit. Ind.* vi. 681.
 **11.** Malay Peninsula, *Griffith*, Kew n. 6355. Malacca, *Griffith* (hb. Wight). Singapore, *Ridley*, 1712, 1715.
 *Distrib.* Java. Borneo.

3. MAPANIA KURZII, *C. B. Clarke in Hook. f. l. c.* vi. 681.
 **11.** Malacca, *Griffith*, Kew n. 6356. Perak, 1750 feet, hb. *King*, 2864, *Wray*, 1852. Penang, Government Hill, *Maingay*, 2275; 1750 feet, hb. *King*, 1587.
 *Distrib.* Endemic.

4. MAPANIA ANDAMANICA, *C. B. Clarke in Hook. f. l. c.* vi. 681.
 **10.** Andamans, *Kurz*, *Helfer*, Kew n. 6298.
 *Distrib.* Endemic.

5. MAPANIA MULTISPICATA, *Ridley in Journ. Singapore Asiat. Soc.* n. 23 [1891] p. 15; *Hook. f. l. c.* vi. 682.
 **11.** Singapore, *Ridley*, 1714.
 *Distrib.* Java.

6. MAPANIA WALLICHII, *C. B. Clarke in Hook. f. l. c.* vi. 682.
 **11.** Singapore, *Wallich*, 3541.
 *Distrib.* Endemic (a var. in Borneo).

7. MAPANIA ZEYLANICA, *C. B. Clarke in Hook. f. l. c.* vi. 682.
 **4.** Kokoole Corle, Pittigalakanda, *Thwaites*, 3029. "Indian Peninsula," *Rottler.*
 *Distrib.* Borneo.

8. MAPANIA IMMERSA, *C. B. Clarke in Hook. f. l. c.* vi. 682.
 **4.** Singhe-rajah Forest, *Thwaites*, 3819.
 *Distrib.* Endemic. (One collection only.)

9. MAPANIA TENUISCAPA, *C. B. Clarke in Hook. f. l. c.* vi. 683.
 **11.** Malacca, *Griffith*, Kew n. 6299. Johore, *Ridley*, 4094.
 *Distrib.* Sumatra.

10. MAPANIA LONGA, *Ridley in Journ. Singapore Asiat. Soc.* n. 23 [1891] p. 14; *Hook. f. l. c.* vi. 683.
 **11.** Singapore, *Ridley*, 169.
 *Distrib.* Borneo.

11. MAPANIA HUMILIS, *Naves et Villar*; *Hook. f. Fl. Brit. Ind.* vi. 683.

**11.** Penang, *Curtis*, 287. Malacca, *Griffith*, Kew n. 6300, *Hervey*. Perak, 2500 feet, hb. *King*, 2554. Singapore, *Ridley*, 1713.

*Distrib.* Malaya.

1. SCIRPODENDRON COSTATUM, *Kurz*; *Hook. f. l. c.* vi. 684.

**4.** Colombo, *Koenig*, *Trimen*.

**11.** Penang, *Wallich*, 3538. Malacca, *Griffith*, Kew n. 6134. Singapore, *Wallich* (hb. Calcutta), *Ridley*.

*Distrib.* Java. Queensland. Samoa.

1. LEPIRONIA MUCRONATA, *L. C. Rich.*; *Hook. f. l. c.* vi. 684.

**4.** Ceylon, *Macrae*, 151, *Walker*; Caltura, *Thwaites*, 3228.

**11.** Malacca, *Griffith*, Kew n. 6307, *Gaudichaud*, 98. Singapore, *Lobb*, *Ridley*, 54.

*Distrib.* Mascarenia. Malaya. Australia. Viti.

1. SCLERIA PERGRACILIS, *Kunth*; *Hook. f. l. c.* vi. 685.

**1.** Kumaon, *Edgeworth*; Almora, 5500 feet, *Strachey & Winterbottom*. Gurhwal, 6000 feet, *Duthie*. Nepal, *Wallich*, 3406 C.

**4.** Ceylon, *Thwaites*, 827; South Ceylon, *Gardner*.

**5.** Madras Peninsula, *Wight*, 2914 (hb. Calcutta). Chota Nagpore, Hazaribagh, *T. Anderson*.

**6.** Behar, Gya, *Kurz*.

**8.** Sylhet, *Wallich*, 3406.

*Distrib.* North Trop. Africa.

2. SCLERIA LITHOSPERMA, *Swartz*; *Hook. f. l. c.* vi. 685.

**3.** Canara, *Talbot*, 562.

**4.** Ceylon, *Walker*, *Koenig*, *Macrae*, 1064.

**5.** Madras Peninsula, *Wight*, 113, 114 (hb. Berlin). Mysore, *G. Thomson*. Central India: Chunda, *Duthie*, 9881. Chota Nagpore, 1750–3000 feet, *C. B. Clarke*, 21195, 34121, 34239.

**7.** Sikkim, 2000 feet, *C. B. Clarke*, 35476.

**8.** Khasia, 2800 feet, *C. B. Clarke*, 42860.

**10.** Pegu and Karen Hills, *Kurz*, 611. Andamans, *Kurz*. Nicobars, *Kurz* (hb. C. B. Clarke, 25975).

**11.** Penang, *Wallich*, 3416. Malacca, *Griffith*, Kew n. 6129. Pahang, *Ridley*, 1461.

*Distrib.* Ethiopia. China. Malaya. Oceania. South-east U.S. Neotropica.

SCLERIA LITHOSPERMA, *Swartz* :

Var. β. (ROXBURGHII), *Thwaites* ; *Hook. f. Fl. Brit. Ind.* vi. 686.

**4.** Ceylon, *Deschamps* ; common, *Thwaites*, 826, 2627.

**5.** Madras Peninsula, *Wight*, 1907, 2308, 2915, *Wallich*, 3418, 3419 (hb. Mus. Brit.), *G. Thomson*.

*Distrib.* Endemic.

3. SCLERIA CORYMBOSA, *Roxb.*; *Hook. f. l. c.* vi. 686.

**3.** Belgaum, *Ritchie*, 869 part.

**4.** Reigam Corle, *Thwaites*, 3319.

**5.** Madras Peninsula, *Roxburgh*, 175 part, *Wight*, 1906, *Wallich*, 3412, *Rottler*.

**8.** Khasia, tropical, *J. D. Hooker & T. Thomson*. Sillet, hb. *Roxburgh*. Soorma R. (plant 10 feet high), *J. D. Hooker*. Chittagong, Seetakoondo, *J. D. Hooker*, 385.

**10.** Pegu, *Kurz*, 2704, 2706.

**11.** Penang, *Curtis*, 490. Malacca, *Griffith*, Kew n. 6116. Goping, *King*, 1092.

*Distrib.* Endemic.

4. SCLERIA RIDLEYI, *C. B. Clarke in Hook. f. l. c.* vi. 686.

**11.** Singapore, *Ridley*, 1641 (hb. Kew).

*Distrib.* Hongkong.

5. SCLERIA TESSELLATA, *Willd.* ; *Hook. f. l. c.* vi. 686.

**2.** Mt. Aboo, *Duthie*, 6716.

**3.** Canara, *Talbot*, 1025. Poona, *Jacquemont*, 513. Nilgiri Mts., *Metz*, 1295, *Schmidt*. Quilon, *Wight*, 2916.

**4.** Ceylon, *Gardner*, 952 ; Galle, *Thwaites*, 3033.

**5.** Madras Peninsula, *Wight*, 2030. Central India: Goona, *King*. Chota Nagpore: Parasnath, *Kurz*.

**7.** Nepal, *Wallich*, 3405 A (but not B). Sikkim, *Griffith*; up to 9000 feet (Lachoong), *J. D. Hooker*.

**8.** Gowhatty, *Griffith*, 1625, 300 feet (hb. *Kurz*). Khasia, 2000–6200 feet, *Griffith*, Kew n. 6125, *J. D. Hooker*; common, *C. B. Clarke*.

**9.** Muneypoor, 3000 feet, *C. B. Clarke*, 42071.
**10.** Pegu, *Kurz*, 2703.
*Distrib.* China. Japan. (A var. in Queensland.)

6. SCLERIA BIFLORA, *Roxb.*; *Hook. f. Fl. Brit. Ind.* vi. 687.
**4.** Ceylon, *Walker*, *Macrae*, 1061; Ambagamowa and Saffragam Districts, *Thwaites*, 3034.
**6.** Lower Bengal, *Roxburgh*, *Wallich*, 3405 B; Serhampore, *Voigt*; Calcutta, *C. B. Clarke*, 3843; Mudhopoor, *C. B. Clarke*, 7781.
**8.** Cachar, *Keenan.*
**11.** Penang, *Didrichsen*, 3460.
*Distrib.* Malaya. Hongkong.

7. SCLERIA STOCKSIANA, *Boeck.*; *Hook. f. l. c.* vi. 687.
**3.** Bombay, *Law* (2 sheets in hb. Kew, 1 in hb. Berlin, 1 in hb. Calcutta). Poona, *Woodrow*, 76, 78.
*Distrib.* Endemic in Bombay.

8. SCLERIA ANNULARIS, *Kunth*; *Hook. f. l. c.* vi. 687.
**3.** Concan and Canara, *Law.*
**5.** Mysore, *Law.* Central India: Chunda, *Duthie.*
**6.** North-west India, *Royle*, 105. Bengal, *Lemann*, *Wallich*, 1028.
*Distrib.* China (Ichang).

9. SCLERIA ZEYLANICA, *Poir.*; *Hook. f. l. c.* vi. 587.
**4.** Ceylon, abundant in southern province, *Thwaites*, 3318, 3796, 3797.
**10.** Nicobars, *Kurz* (25966, hb. C. B. Clarke). Tenasserim, *Helfer*, Kew n. 6133/1.
**11.** Singapore, fide *Ridley.*
*Distrib.* Borneo. Amboyna.

10. SCLERIA FLACCIDA, *C. B. Clarke in Hook. f. l. c.* vi. 688.
**8.** Seebsagur, Golaghat, 350 feet, *C. B. Clarke*, 40744.
**10.** Pegu, *Kurz*, 2702.
*Distrib.* Endemic.

11. SCLERIA CARICINA, *Benth.*; *Hook. f. l. c.* vi. 688.
**3.** Quilon, *Wight*, 2028, 2918 (in herb. Calcutta, 1360).
**4.** Ceylon, *Koenig*, *Macrae*, 159, 1057; common, *Thwaites*, 3035.
**5.** Madras Peninsula, *Heyne.*

**7.** Sikkim Terai, 500 feet, *C. B. Clarke*, 36787; Titaliya, *Kurz.*

**8.** Gowhatty, *Griffith*, 1351, 1353, *Simons*, 99. Sylhet, *Wallich*, 3540, *J. D. Hooker.* Chittagong, *J. D. Hooker*, 234.

**10.** Pegu, *Kurz*, 6114. Arracan, *Kurz.* Tenasserim (or Andamans), *Helfer*, Kew n. 6114. Andamans, *Kurz.* Nicobars, *Kamphoevener*, 2479.

**11.** Singapore, *Ridley*, 53.

*Distrib.* China. Malaya. Queensland.

12. SCLERIA NEESII, *Kunth*; *Hook. f. Fl. Brit. Ind.* vi. 688.

**4.** Caltura, *Macrae*, 118, 1072; Bentotte, *T. Anderson*; common, *Thwaites*, 3037.

*Distrib.* Endemic (a var. in Borneo).

13. SCLERIA HEBECARPA, *Nees*; *Hook. f. l. c.* vi. 689.

**3.** Malabar (or Concan), *Stocks.* Anamallay Mts., *Beddome.*

**4.** Ceylon, *Macrae*, 1065; Central Province (Allagalla), 3000 feet, *Thwaites*, 3031, 3763.

**5.** Madras Peninsula, *Wight*, 2378. Chota Nagpore, 1000–2000 feet, *C. B. Clarke*, 34163, 34417. Rajmahl, *Wallich*, 3417 part.

**6.** Dacca, *C. B. Clarke*, 4686, 7632, 17104.

**7.** East Himalaya, *Griffith*, Kew n. 6126. Sikkim, 500–1250 feet, *Gamble*, 861 B, *C. B. Clarke*, 26796, 35140, 36963.

**8.** Khasia, 4000–5000 feet, *C. B. Clarke*, 40052, 40224.

**10.** Pegu, *Kurz*, 608, 609, 610. Arracan, *Kurz.* Moulmein, *Wallich*, 3415. Mergui, *Griffith.* Tenasserim (or Andamans), *Helfer*, Kew n. 6117.

**11.** Penang, *Curtis*, 1795.

*Distrib.* Indo-China. Oceania.

SCLERIA HEBECARPA, *Nees*:

Var. β. PUBESCENS, *C. B. Clarke in Hook. f. l. c.* vi. 689.

**5.** Chota Nagpore, 1750 feet, *C. B. Clarke*, 33843.

**7.** Sikkim, 1000–3000 feet, *C. B. Clarke*, 11892, 11893, 24924, 25084, 36237, 36239.

**8.** Upper Assam, *Jenkins*, 209; 350 feet, *C. B. Clarke*, 40742. Naga Hills, 5500 feet, *C. B. Clarke*, 41553. Khasia, 2000–3000 feet, *C. B. Clarke*, 40619, 44773.

**10.** Burma, *Wallich*, 3414.

*Distrib.* China. Malaya.

14. SCLERIA THOMSONIANA, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 689.

**8.** Khasia, alt. 0–3000 feet, *J. D. Hooker*, 2214, *C. B. Clarke*, 15861, 17521, 45080.

**9.** Muneypoor, 2750 feet, *C. B. Clarke* 42053.

*Distrib.* Endemic.

15. SCLERIA ALTA, *Boeck.*; *Hook. f. l. c.* vi. 690.

**6.** N.E. Bengal, Mudhopoor, *C. B. Clarke*, 7779. Serhampore, *Voigt.*

**8.** East Bengal, *Lemann*, *Griffith*; Pundua, *J. D. Hooker*, 394.

*Distrib.* Endemic.

16. SCLERIA ELATA, *Thwaites*, partly; *Hook. f. l. c.* vi. 690.

**3.** Anamallay Mts., *Beddome.* Pulney Hills, *Wight*, 2917.

**4.** Ceylon, up to 5000 feet, *Thwaites*, 3030.

**7.** Nepal, *Wallich*, 3408 A, C. Sikkim, hot valleys, *J. D. Hooker*; Kolbong, *T. Anderson*, 1346; Dulkajhar, 600 feet, *C. B. Clarke*, 35110. Darjeeling, *Griffith*, Kew n. 6119.

**8.** Assam, *Griffith*, Kew n. 6121, common, *C. B. Clarke*; (very hairy), *Masters*, 223. East Bengal, *Griffith*, Kew n. 6122. Khasia, 2750–5000 feet, common, *C. B. Clarke*, 44757. Cachar, *J. D. Hooker*, *Keenan.* Sylhet, in the jheels, *J. D. Hooker.* Chittagong, 50 feet, *C. B. Clarke*, 19554.

**10.** Burma, *Griffith*, Kew n. 6131. Mergui, *Griffith*, 88.

*Distrib.* Java. New Guinea.

SCLERIA ELATA, *Thwaites*:

Var. *β.* LATIOR, *C. B. Clarke in Hook. f. l. c.* vi. 690.

**7.** Sikkim, 750–2000 feet, *C. B. Clarke*, 35110, 35115, 36218, 36774, 37042. Duphla Hills, 2800 feet, *Lister*, 286.

**8.** Assam, 500–2000 feet, *C. B. Clarke*, 36726, 37133, 38087, 40616, 43274. Upper Assam, *Jenkins.* Naga Hills, *Griffith*, Kew n. 6127; 600 feet, *C. B. Clarke*, 40778. Cachar, *C. B. Clarke*, 7073. R. Soorma, *J. D. Hooker*, 323.

*Distrib.* Java. (Also hb. *King*, n. 2506 from Perak, is intermediate between the type *S. elata* and its var. *β. latior.*)

SCLERIA ELATA, *Thwaites*:

Var. *δ*. DECOLORANS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 690.

**7.** Darjeeling, 5500 feet, *C. B. Clarke*, 24841.

**8.** Khasia, *Griffith*, Kew n. 6123, *J. D. Hooker*, 752; 4000–5000 feet, common, *C. B. Clarke*, 5250, 14291, 15127, 18993, 41822, 45601.

**9.** Muneypoor, 6000 feet, *Watt*, 5907.

**11.** Penang, 2500 feet, *Rink*.

*Distrib.* China.

17. SCLERIA CHINENSIS, *Kunth*; *C. B. Clarke in Hook. f. l. c.* vi. 690.

**11.** Singapore, *Ridley*, n. 1556.

*Distrib.* China. Malaya. North Australia.

SCLERIA CHINENSIS, *Kunth*:

Var. *β*. BIAURICULATA, *C. B. Clarke in Hook. f. l. c.* vi. 690.

**4.** Ceylon, *Thwaites*, 825 (hb. Kew, Mus. Brit.), 3031 (hb. DC., Berlin), 3032 (hb. Mus. Brit.).

*Distrib.* Endemic.

18. SCLERIA RADULA, *Hance*; *Hook. f. l. c.* vi. 691.

**11.** Perak, 350 feet, hb. *King*, 1929.

*Distrib.* China.

19. SCLERIA PSILORRHIZA, *C. B. Clarke in Hook. f. l. c.* vi. 691.

**11.** Malay Peninsula, hb. *Kew*.

*Distrib.* Cambodia. (The habitat Malay Peninsula is merely guess.)

20. SCLERIA ORYZOIDES, *Presl*; *Hook. f. l. c.* vi. 691.

**4.** Ceylon, *Koenig*, *Walker*, 46, *Macrae*, 122, 1069; very common in South Ceylon, *Thwaites*, 828.

**5.** Madras Peninsula, *Rottler*, *Wallich*, 3413 part.

**8.** Assam, *Masters*, *Jenkins*, hb. *Hance*, 7966. Sylhet *Wallich*, 3539.

**11.** Malacca, *Griffith*, Kew n. 6130, *Gaudichaud*, 90. Trang, *Kunstler*, 1413.

*Distrib.* Mozambique. Malaya. North Australia.

21. Scleria Hookeriana, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 691.

**8**. Khasia, *J. D. Hooker*, *G. Mann*, *Gallatly*, 461; 4250–6000 feet, common on the north face, *C. B. Clarke*, 38448, 38451, 38598, 38618, 38851, 40096, 40576, 43954, 44603, 44623, 45719. Naga Hills, 5000 feet, *C. B. Clarke*, 41669.

**9**. Muneypoor, 4500 feet, *Watt*, 7139, 7153.

*Distrib.* Endemic.

22. Scleria khasiana, *C. B. Clarke in Hook. f. l. c.* vi. 692.

**8**. Khasia, 4500–6000 feet, frequent, *C. B. Clarke*, 40052, 44613, 44683, 44798.

*Distrib.* Endemic.

23. Scleria junciformis, *Thwaites*; *Hook. f. l. c.* vi. 692.

**4**. Ceylon, *Macrae*, 1062; Caltura, *Moon*; Reigam Corle *Thwaites*, 3225.

*Distrib.* Endemic in Ceylon.

24. Scleria melanostoma, *Boeck.*; *Hook. f. l. c.* vi. 692.

**5**. Madras Peninsula, *Wight*, 2377, hb. Berlin (not 2377 in hb. Kew). Courtallum, *Wight*, 958, 1002.

**8**. East Bengal, *Griffith*, Kew n. 6120, *J. D. Hooker*, *C. B. Clarke*, 18226, 45517.

*Distrib.* Java.

25. Scleria bancana, *Miq.*; *Hook. f. l. c.* vi. 693.

**10**. Mergui, *Kurz*. Tenasserim (or Andamans), *Helfer*, Kew n. 6118.

**11**. Malacca, *Gaudichaud*, 91, *Griffith*. Singapore, *Wallich*, 3409, *Kurz*, 3026, *Hullett*, 75, *Ridley*, 160, 1556.

*Distrib.* Malaya. Oceania.

26. Scleria multifoliata, *Boeck.*; *Hook. f. l. c.* vi. 693.

**10**. Rangoon, *Wallich*, 3411 part. Tavoy, *Wallich*, 3407 part, 3411 part. Mergui Archipelago, *J. Anderson*. Tenasserim or Andamans, *Helfer*, Kew n. 6132 Penang, *Wallich*, 3410 part, *Curtis*, 22; 2000 feet, *Kunstler*, 1544 part.

**11**. Penang, *Wallich*, 3410 part. Malacca, *Gaudichaud*, 92 bis, *Griffith* (hb. *Hance* n. 9307). Singapore, *Walker*, 242. Pahang, *Ridley*. Pulo Bissar, *Griffith*, Kew n. 6117 part.

*Distrib.* Malaya. Timor Laut.

SCLERIA MULTIFOLIATA, *Boeck.*:

Var. PILOSULA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 693.

**11.** Penang, *Stoliczka*, *Kunstler*, 1544 part, hb. *King*, 1657.

*Distrib.* Java.

SCLERIA MULTIFOLIATA, *Boeck.*:

Var. OPHIRENSIS, *C. B. Clarke in Hook. f. l. c.* vi. 693.

**11.** Malacca, Mt. Ophir, 5000 feet, *Hullett*, 869.

*Distrib.* Endemic.

27. SCLERIA SUMATRENSIS, *Retz.*; *Hook. f. l. c.* vi. 693.

**3.** Travancore, *Wallich*, 3408 B; Quilon, *Wallich*, 3413 part.

**4.** Ceylon, *Macrae*, 169, 1063, *Walker*, 22; Ambagamowa, *Thwaites*, 3783.

**6.** Lower Bengal, Furidpore, *C. B. Clarke*, 7482; Burisal, 16922.

**8.** Sylhet, *Wallich*, 3420 part. Chittagong, *Roxburgh*, 23, *J. D. Hooker*, 419; Rungamuttia, *C. B. Clarke*, 19554; Demagri, *Lister*, 302.

**10.** Tenasserim (or Andamans), *Helfer*, Kew n. 6133. Nicobars, *Kurz*.

**11.** Penang, *Wallich*, 3407 part. Perak, *Kunstler*, 2045. Malacca, *Delessert*, *Griffith*, 2855, Kew n. 6133. Singapore, *Wallich*, 3407, *T. Anderson*, 198, *Schottmueller*, 458, *Ridley*, 25.

*Distrib.* Malaya.

28. SCLERIA LEVIS, *Retz.*; *Hook. f. l. c.* vi. 694.

**4.** Ceylon, *Fraser*, 110, *Burmann*, 37, *Thwaites*, 2745.

**8.** Assam, *Masters*. Khasia, Pundua, 200 feet, *J. D. Hooker*, 368. Chittagong, Seetakoondo, 1000 feet, *J. D. Hooker*, 512.

**10.** Pegu, *Kurz*, 607. Rangoon, *Wallich*, 3411 part. Moulmein, *Falconer*, 12. Nicobars, *Kurz*.

**11.** Penang, *Wallich*, 3410 part. Malacca, *Gaudichaud*, 92, *Griffith*. Singapore, *Kurz*. Johore, *Ridley*, 1719. Pahang, *Ridley*, 1479. Pulo Bissar, *Griffith*.

*Distrib.* Hongkong. Malaya.

29. SCLERIA BRACTEATA, *Cav.*:

Var. β. ASSAMICA, *C. B. Clarke in Hook. f. l. c.* vi. 694.

**8.** Assam, *Masters* (hb. Kew).

*Distrib.* Endemic (*i. e.* the Var. β. The type *S. bracteata* is abundant in all tropical America).

1. KOBRESIA SETICULMIS, *Boeck.*; *Hook. f. Fl. Brit. Ind.* vi. 695.
   **7.** Sikkim, 13,000 feet, Lachen and Momay, *J. D. Hooker.*
   *Distrib.* Endemic.

2. KOBRESIA HOOKERI, *Boeck.*; *Hook. f. l. c.* vi. 695.
   **7.** Sikkim, 11,000–13,000 feet, Lachen, *J. D. Hooker.* Singalelah, *C. B. Clarke*, 25648.
   *Distrib.* Endemic.

KOBRESIA HOOKERI, *Boeck.*:
Var. ? β. DIOICA, *C. B. Clarke in Hook. f. l. c.* vi. 695.
**7.** Sikkim, 13,000 feet, Namdee, *Pantling.*
*Distrib.* Endemic.

3. KOBRESIA ANGUSTA, *C. B. Clarke in Hook. f. l. c.* vi. 695.
   **7.** Sikkim, 12,000 feet, Sundukphoo, *C. B. Clarke*, 34991, 34993.
   *Distrib.* Endemic.

4. KOBRESIA VAGINOSA, *C. B. Clarke in Hook. f. l. c.* vi. 695.
   **7.** Sikkim, 15,000 feet, Momay, *J. D. Hooker.*
   *Distrib.* Endemic.

5. KOBRESIA TRINERVIS, *Boeck.*; *Hook. f. l. c.* vi. 695.
   **1.** Gurhwal, 13,000 feet, *Strachey & Winterbottom*, 19. Nepal, *Royle*, 138.
   *Distrib.* Endemic.

6. KOBRESIA FOLIOSA, *C. B. Clarke in Hook. f. l. c.* vi. 696.
   **1.** Gurhwal, 11,000–13,000 feet, *Duthie*, 57, 4494.
   *Distrib.* Endemic.

7. KOBRESIA FISSIGLUMIS, *C. B. Clarke in Hook. f. l. c.* vi. 696.
   **1.** Nepal, 12,500 feet, Nampa Gadh, *Duthie*, 6092.
   *Distrib.* Endemic.

8. KOBRESIA PYGMÆA, *C. B. Clarke in Hook. f. l. c.* vi. 696.
   **1.** Ladak, 12,000–15,000 feet, *T. Thomson.* Kunawur, *Jacquemont*, 1783.
   **7.** Sikkim, 13,000–15,000 feet, Momay and Kongra Lama, *J. D. Hooker.* Pharee, hb. *King.*
   *Distrib.* Endemic.

9. KOBRESIA FILICINA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 696.

**1.** Simla, 10,000 feet, Fagu, *T. Thomson.* Kumaon, Ralum Valley, *Duthie*, 3463.

*Distrib.* Endemic.

10. KOBRESIA DUTHIEI, *C. B. Clarke in Hook. f. l. c.* vi. 697.

**1.** Kumaon, 11,000–15,000 feet, *Duthie*, 3461, 6093, 6094. Gurhwal, *Duthie*, 5016.

*Distrib.* Endemic.

11. KOBRESIA CAPILLIFOLIA, *C. B. Clarke in Hook. f. l. c.* vi. 697.

**1.** Kurrum Valley, 9000–12,000 feet, *Aitchison*, 230, 410, 745. Kashmir, 9000–11,000 feet, *Duthie*, frequent, *C. B. Clarke.* Zanskar, *T. Thomson.* Spiti, *Schlagintweit*, 2472. Kunawur, *Jacquemont*, 1598. Rongdu, *Winterbottom*, 790. Gurhwal, 12,500 feet, *Duthie*, 66.

*Distrib.* Endemic.

12. KOBRESIA SCHŒNOIDES, *Boeck.*; *Hook. f. l. c.* vi. 697.

**1.** Kurrum Valley, *Aitchison*, 301. Ladak, *Schlagintweit*, 1421. Kashmir, 13,000 feet, *C. B. Clarke*, 31069. Lahoul, *Jaeschke.* Upper Indus, *T. Thomson.* Nubra, *Schlagintweit*, 2085. Kunawur, *Jacquemont*, 1542, 1596. Gurhwal, 12,000 feet, *Duthie*, 67, 372. Kumaon, 16,000 feet, *Strachey & Winterbottom.*

**7.** Sikkim, 15,000 feet, *J. D. Hooker.*

*Distrib.* Caucasus. Siberia. Alatau. Yarkand.

13. KOBRESIA NITENS, *C. B. Clarke*; *Hook. f. l. c.* vi. 697.

**1.** Gilgit, *Duthie.* Kashmir, *C. B. Clarke*, 28918 bis, 29697 29840. Gurhwal, *Duthie*, 370. Kumaon, *Duthie*, 3462.

*Distrib.* Endemic.

14. KOBRESIA ROYLEANA, *Boeck.*; *Hook. f. l. c.* vi. 698.

**1.** West Himalaya, *Royle*, 109, 149. Nubra, *T. Thomson.* Kashmir, 9,000–11,000 feet, *C. B. Clarke*, 28863, 28870. Kunawur, *T. Thomson.* Leh, 13,000 feet, *Stoliczka.* Kumaon, 15,000 feet, *Duthie*, 6069. West Nepal, 10,000 feet, *Duthie*, 6068.

**7.** Sikkim, 16,000, Samding, *J. D. Hooker.*

*Distrib.* Cabul. Alatau. Yarkand.

15. Kobresia uncinoides, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 698.
    7. Sikkim, 10,000–14,000 feet, *J. D. Hooker*, frequent, *C. B. Clarke*. Bhotan, *Griffith*, 645, Kew n. 6074.

    *Distrib.* Lhassa.

16. Kobresia laxa, *Boeck.*; *Hook. f. l. c.* vi. 698.
    1. West Himalaya, *Royle*, 81, 102, frequent, *T. Thomson*. Baltisthan, *Schlagintweit*. Gilgit, *Giles*. Skardo and Dras, *C. B. Clarke*. Kashmir, 6500–10,000 feet, frequent, *C. B. Clarke*. Riv. Kishagunga, *Winterbottom*, 574. Gurhwal, *Duthie*, 74, 75. Kumaon, *T. Anderson*. West Nepal, *Duthie*, 6090.
    7. Sikkim, 12,000 feet, Lachen, *J. D. Hooker*.

    *Distrib.* Endemic.

17. Kobresia curvirostris, *C. B. Clarke in Hook. f. l. c.* vi. 699.
    7. Sikkim, 14,000 feet, Tungu, *J. D. Hooker*.

    *Distrib.* Endemic.

18. Kobresia filifolia, *C. B. Clarke in Journ. Linn. Soc.* xx. [1883], p. 381.

    [*K. macrantha*, Boeck. Cyp. Novæ, Heft 1 [1888], 39; Hook. f. Fl. Brit. Ind. vi. 699.]
    1. Nubra, *Schlagintweit*, 2018, 2426. Ladak, *Schlagintweit*, 1344.

    *Distrib.* Dahuria.

1. Carex incurva, *Lightf.*; *Hook. f. l. c.* vi. 700.
    1. Kunawur, alt. 18,300 feet, *Jacquemont*, 1785. North Kashmir to Karakorum, 12,000–16,000 feet (Zanskar, Parang Valley, Piti, Nubra), *T. Thomson*.

    *Distrib.* Europe. Asia. North and Alpine South America.

2. Carex stenophylla, *Wahlenb.*; *Hook. f. l. c.* vi. 700.
    1. Le, Nubra, and Piti, *T. Thomson*. Lahoul, *Jaeschke*, 127. Wakhan, *Giles*, 55, 96. Gilgit, 9000–10,000 feet, *Duthie*, 12, 435. Karakorum, 11,500 feet, *C. B. Clarke*, 30419.
    2. Kuram Valley, 7000–10,000 feet, *Aitchison*, 92, 194, 493.

    *Distrib.* Palæarctica. Nearctica.

3. Carex divisa, *Huds.*; *Hook. f. l. c.* vi. 701.
    2. Kuram, 10,000 feet, *Aitchison*, 818.

    *Distrib.* Palæarctica. Cape.

4. Carex vulpinaris, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 702.

**1.** Kashmir, *Jacquemont*, 338, 362. Lahoul, *Schlagintweit*, 2813, Kunawur, 4000 feet, *Jacquemont*, 1605, *Royle*, 73. Simla, *Munroe*, 2417. Tihri-Gurhwal, 11,000–12,000 feet, *Duthie*, 55.

*Distrib.* Endemic.

5. Carex curaica, *Kunth*; *Hook. f. l. c.* vi. 702.

**1.** Devil's Plains, 10,500–14,500 feet, *C. B. Clarke*, 29626, 29842. Lower Karakash, 14,000 feet, *Henderson*, 367.

*Distrib.* Mongolia.

6. Carex nubigena, *D. Don*; *Hook. f. l. c.* vi. 702.

**1.** West Himalaya, *Royle*, 107, 127, 132, 133, 135 part. Budrawur, 6000–8000 feet, *T. Thomson*. Rajaori, *Jacquemont*, 1353. Simla, 5000–7000 feet, *Munro*, 2426; Mundali, *Munro*, 2425. Tongridge, 7000–8000 feet, *Edgeworth*. Chini, *T. Thomson*. Nynee Tal, *T. Thomson*, 583. Gurhwal, *Jacquemont*, 591. Kumaon, 8000 feet, *Strachey & Winterbottom*, 5. Tihri-Gurhwal, 10,000–11,000 feet, *Duthie*, 68.

**2.** Sindh, *Pinwill*.

**3.** Nilgiri Mts., *Wight*. Anamallays, *Beddome*.

**4.** Ceylon, *Gardner*, 918, *Maxwell*; 7000 feet, *Thwaites*, 2395.

**7.** Nepal, *Wallich*, 3396. Sikkim, 6000–12,000 feet, Lachen and Tungu, *J. D. Hooker*. Bhotan, *Griffith*, 2666, Kew n. 6068.

**8.** East Bengal, *Griffith*, 1115, Kew n. 6068. Khasia, *Griffith*, 4000–6000 feet. Cherra to Nunklow, *J. D. Hooker*, 4000–6000 feet. Maophlang to Jowye, *C. B. Clarke*, 38227, 44820.

*Distrib.* Cabul. Indo-China.

7. Carex muricata, *Linn.*; *Hook. f. l. c.* vi. 703.

**1.** Kashmir, Alibad, 9000 feet, *C. B. Clarke*, 28644. Ramoo, 6000 feet, *C. B. Clarke*, 28533.

**2.** Kuram, Shahzan, *Aitchison*, 670.

*Distrib.* Europe. North and Central Asia. Temperate and Frigid North America.

Carex muricata, *Linn.*:

Var. foliosa, *C. B. Clarke in Hook. f. l. c.* vi. 703.

**1.** West Himalaya, *Royle*, 106, 126, 129, *Mrs. Walker*. Kashmir, 6000–8000 feet, *T. Thomson*. Mussooree, *Jacque-*

*mont*, 505. Nynee Tal, *T. Thomson*, 638. Kumaon, 7000 feet, *Strachey & Winterbottom*, 4; 6000–7000 feet, *Duthie*, 3466.

**2.** Sindh, *Pinwill.*

**3.** Nilgiri Mts., *Wight*, 30. Pulney Hills, *Wight*, 3179.

**7.** Nepal, *Wallich*, 3387. Sikkim, 8000 feet, *J. D. Hooker.*

**8.** Khasia, *Griffith*, Kew n. 6067. Cherra, 4000 feet, *J. D. Hooker*, 1117.

*Distrib.* Endemic.

[*C. Henningshiana*, Boeck. MS. in Schlagintweit n. 3698 was this plant.]

8. CAREX THOMSONI, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 703.

**1.** West Himalaya, 6000–8000 feet, *T. Thomson.* Kumaon, *T. Thomson*, 1081.

**7.** Nepal, R. Tambur, *J. D. Hooker.* Sikkim, Great Rungait, *J. D. Hooker.* Little Rungait, 1000–2000 feet, *J. D. Hooker.* Bhotan, *Nuttall.*

**8.** Upper Assam, R. Dihong, *Griffith*, Kew n. 6073. Khasia, Upper Boga Pani, 4500 feet, *J. D. Hooker*, *C. B. Clarke.*

*Distrib.* Tonkin.

9. CAREX FLUVIATILIS, *Boott*; *Hook. f. l. c.* vi. 703.

**9.** Hookhoom, Wullaboom, *Griffith*, Kew n. 6103.

*Distrib.* China. Japan.

10. CAREX TERETIUSCULA, *Gooden.*; *Hook. f. l. c.* vi. 703.

**1.** Kashmir, Sind Valley (April), 6000–7000 feet, *T. Thomson.*

**7.** Bhotan, *Griffith*, 2663, Kew n. 6104.

*Distrib.* Europe. North Asia. N. America.

The Kashmir plant is *C. mitis*, Boeck., put by Boott in his hb. propr. with *C. teretiuscula*. The Bhotan plant is named by Boott "*C. teretiuscula*, Boott (*C. Ehrartiana*, Hoppe)."

11. CAREX LONGIPES, *D. Don*; *Hook. f. l. c.* vi. 704.

**3.** Nilgiri Mts., *Wight*, 7, 11.

**7.** Nepal, *Wallich*, 3388 part. Sikkim, 7000 feet, *J. D. Hooker.* Lachen, *J. D. Hooker.*

**8.** Khasia, Mairung, 6000 feet, *J. D. Hooker.* Syong, *J. D. Hooker.*

*Distrib.* China.

CAREX LONGIPES, *D. Don* :

Var. β. NEPALENSIS, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 704.

**7.** Nepal, *Wallich*, 3388 part. Sikkim, 7000 feet, *J. D. Hooker.* Lachen, 7000 feet, *J. D. Hooker.*

*Distrib.* Endemic.

CAREX LONGIPES, *D. Don* :

Var. γ. DISSITIFLORA, *C. B. Clarke*; *Hook. f. l. c.* vi. 705.

**3.** Nilgiri Mts., *Wight*, 5, 1919. Canoor, 6000–7000 feet, *C. B. Clarke*, 10992, 11029, 11077. Anamallays, *Beddome.*

**8.** Khasia, Shillong, 5500–6000 feet, *C. B. Clarke*, 43393, 43456.

*Distrib.* China.

12. CAREX BRUNNEA, *Thunb.*; *Hook. f. l. c.* vi. 705.

**1.** West Himalaya, *Falconer.* Bankhote, *Fleming*, 371. Dalhousie, 4500 feet, *C. B. Clarke*, 23193. Mussoorie, *Royle*, 103. Nepal, *Wallich*, 3379 part.

**2.** Sind, *Pinwill.*

**3.** Nilgiri Mts., *Wight*, 5 part; Canoor, 7000 feet, *C. B. Clarke*, 10962.

**4.** Ceylon, *Thwaites*, 2632.

**8.** East Bengal, *Griffith*, 1026, Kew n. 6081.

**9.** Muneypoor, 3750 feet, *C. B. Clarke*, 41995.

*Distrib.* Mascarenia. Japan. Australia. Sandwich Isles.

13. CAREX TEINOGYNA, *Boott*; *Hook. f. l. c.* vi. 705.

**8.** Khasia, alt. 4000–6000 feet, Mausmai, *Griffith*, Kew n. 6082; Mamloo, *Hooker f. & T. Thomson*; Pomrang, *J. D. Hooker*, 2032.

**9.** Taondong, *Wallich*, 3534. (But the specimen has no utricles and the determination doubtful.)

*Distrib.* Endemic.

14. CAREX LONGICRURIS, *Nees*; *Hook. f. l. c.* vi. 705.

**1.** West Himalaya, *Royle*, 93. Kishtwar, 4000 feet, *C. B. Clarke*, 31434. Simla, 8000 feet, *T. Thomson.*

**3.** Nilgiri Mts., *Wight*, 1918.

**4.** Neuera Ellia, *Thwaites*, 2749.

**7.** Nepal: Gossain Than, *Wallich.*

*Distrib.* Endemic.

15. CAREX REMOTA, *Linn.*:

Var. *β*. ROCHEBRUNI, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 706.

**1.** West Himalaya, *Royle*, 139, 140, 144. Binsur, 7400 feet, *Madden*. Serain, 9000–10,000 feet, *Edgeworth*. Kashmir, 7000 feet, *C. B. Clarke*, 28577. Simla, 8000 feet, *T. Thomson*.

**7.** Sikkim, 9000–12,000 feet (Tonglo, Lachen), *J. D. Hooker*.

**8.** Khasia, 4500 feet (Vale of Rocks), *C. B. Clarke*, 43689.

*Distrib.* of this Var. *β*.—China. Japan.

16. CAREX CANESCENS, *Linn.*; *Hook. f. l. c.* vi. 706.

**1.** Kashmir, 10,500 feet (Barzil), *C. B. Clarke*, 29630; 12,000 feet (Palgam), *C. B. Clarke*, 31072.

*Distrib.* Cool parts of Europe, Asia, and North America; also in the extremity of South America.

17. CAREX ALTA, *Boott*; *Hook. f. l. c.* vi. 707.

**8.** Khasia, 5800 feet (Molim), *C. B. Clarke*, 43622.

**9.** Muneypoor, 5000–6000 feet, *Watt*, 6309, 6807.

*Distrib.* Java.

18. CAREX COOPTANDA, *C. B. Clarke in Hook. f. l. c.* vi. 707.

**8.** Khasia, *Griffith*.

*Distrib.* Endemic. (Three pieces, one collection, laid in hb. Kew, with note by Boott.)

19. CAREX PRÆLONGA, *C. B. Clarke in Hook. f. l. c.* vi. 707.

**7.** Sikkim, 7500 feet (Dikeeling), *C. B. Clarke*, 27858, 27879; 9000 feet (Tonglo), *C. B. Clarke*, 35038.

*Distrib.* Endemic.

This species is *C. longispicata*, Boeck. MS. in Schlagintweit, n. 1469, but I have not discovered this name published.

CAREX PRÆLONGA, *C. B. Clarke*:

Var. *β*. ANGUSTIOR, *C. B. Clarke in Hook. f. l. c.* vi. 707.

**8.** Khasia, 5000 feet (Shillong), *C. B. Clarke*, 43410; 4500 feet (Vale of Rocks), *C. B. Clarke*, 43677, 43690.

**9.** Shan Hills, 5000 feet, *Collett*, 646.

*Distrib.* Endemic.

20. CAREX TERES, *Boott*; *Hook. f. l. c.* vi. 707.

**7.** Sikkim, 8000–9000 feet (Sinchul), *J. D. Hooker*; Tonglo, *C. B. Clarke*, 35636; Sundukphoo, *C. B. Clarke*, 35667.

*Distrib.* Endemic.

21. CAREX SIKKIMENSIS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 708.
   **7.** Sikkim: Jongri, 12,000–13,000 feet, *C. B. Clarke*, 25947, 26080, 26139.
   *Distrib.* Endemic.

22. CAREX CERNUA, *Boott*; *Hook. f. l. c.* vi. 708.
   **8.** Near Sudiya, *Griffith*, n. 1489, Kew n. 6099.
   *Distrib.* Tonkin, Japan.

23. CAREX PHACOTA, *Spreng.*; *Hook. f. l. c.* vi. 708.
   **1.** Gurhwal, *Jacquemont*, 642. Nipal, *Wallich*, 3394 part, 3395 part.
   **3.** Nilgiri Mts., *Wight*, *Metz*, 1292. Pulney Mts., *Wight*, 3178.
   **4.** Ceylon, *Gardner*, 944, *Walker*, *Thwaites*, 2965.
   **5.** Central India: Pachmarhi, *Duthie*, 10590.
   **7.** Sikkim, 6000–7000 feet (Lachoong), *J. D. Hooker*.
   **8.** Assam, *Jenkins*, 714. Khasia, *Griffith*, Kew n. 6075; 6000 feet (Shillong), *C. B. Clarke*, 43384, 43430. Cachar, *Keenan*.
   **9.** Patkoye Mts. and North Burma, *Griffith*, Kew n. 6075.
   *Distrib.* China. Malaya. Japan. South Africa.

24. CAREX PRUINOSA, *Boott*; *Hook. f. l. c.* vi. 709.
   **8.** Khasia, *Griffith*, Kew n. 6106; 4200 feet (Cherra Coalhill), *C. B. Clarke*, 43847.
   *Distrib.* Java.

25. CAREX ARNOTTIANA, *Drejer*; *Hook. f. l. c.* vi. 709.
   **4.** Ceylon, 6000 feet, *Walker*, 268, *Thwaites*, 3219.
   *Distrib.* Endemic.

26. CAREX NOTHA, *Kunth*; *Hook. f. l. c.* vi. 709.
   **1.** West Himalaya, *Royle*, 110, 145. Kunawur, *Royle*, 125, *Jacquemont*, 1345; Karh, 5000–8000 feet, *Edgeworth*. Chargaon, 5000 feet, *Munro*, 2432. Dadooka Taotea, *T. Thomson*. Tihri-Gurhwal, 9000–11,000 feet, *Duthie*, 53, 54. Gurhwal, *T. Thomson*, 1112.
   **7.** Upper Sikkim, *Pantling*; Natong, *Dongboo*. Bhotan, *Griffith*, 2664, Kew n. 6070.
   *Distrib.* Endemic.

27. Carex fuscata, *C. B. Clarke in Hook. f. l. c.* vi. 710; *Boott, MS.*

7. Sikkim, 9000–12,000 feet (Lachen), *J. D. Hooker.*

*Distrib.* Endemic. (Once collected apparently.)

28. Carex rubro-brunnea, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 710.

8. Khasia: Boga Pani, 2000 feet, *C. B. Clarke*, 7210; 4500–5500 feet, Vale of Rocks, Mairung, Shillong, *C. B. Clarke*, 43465, 43667, 44071.

9. Muneypoor, *Watt.*

*Distrib.* Endemic.

29. Carex Prescottiana, *Boott*; *Hook. f. l. c.* vi. 710.

8. Khasia: Mairung, *J. D. Hooker*, 1518; Nungklow, *J. D. Hooker*, (?) *Wallich*, n. 3386.

*Distrib.* Japan.

30. Carex cæspititia, *Nees*; *Hook. f. l. c.* vi. 710.

8. Sylhet, *Wallich*, 3392; Companigunj, 200 feet, *C. B. Clarke*, 14350, 42735, 42739.

*Distrib.* Endemic. (Wallich's collection probably came from Companigunj.)

31. Carex rigida, *Gooden.*; *Hook. f. l. c.* vi. 711.

1. West Himalaya, *Royle.* Tibet, *Pike*; Luptel, 14,500 feet, *Strachey & Winterbottom*, 537. Kurram, *Winterbottom*, 675. Wakhan, 9000 feet, *Giles*, 87. Karakorum, 13,000 feet, *C. B. Clarke*, 30342. Barzil, 10,500 feet, *C. B. Clarke*, 29623. Lahoul, *Jaeschke*, 122. Kunawur, *Jacquemont*, 1763.

7. Sikkim: Lachen, 12,000 feet, *J. D. Hooker.*

*Distrib.* Cool parts of the Northern Hemisphere. Chile.

[*C. cyclocystis*, Boeck. Cyp. Novæ, Heft 1 [1888] p. 47, was this species.]

32. Carex vulgaris, *Fries*; *Hook. f. l. c.* vi. 711.

1. Kashmir: Barzil, 10,000–12,000 feet, *C. B. Clarke*, 29612, 29614, 29711; Deosai, 13,000 feet, *C. B. Clarke*, 29825. Tibet, 14,000-16,000 feet, *T. Thomson*; Leptil, 15,000 feet, *Strachey & Winterbottom*, 12; Gilgit, *Giles*, 197. Lahoul, *Jaeschke*, 122 *a.*

*Distrib.* Cool parts of the Northern Hemisphere.

CAREX VULGARIS, *Fries*:

Var. β. DISTRACTA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 711.

**1.** Kashmir: Gurais, 8000 feet, *C. B. Clarke*, 29488.

*Distrib.* Endemic.

33. CAREX EROSTRATA, *C. B. Clarke in Hook. f. l. c.* vi. 711; *Boott MS.*

**1.** Kumaon: Barji Kang Pass, 14,500 feet, *Strachey & Winterbottom*, 22.

*Distrib.* Endemic.

34. CAREX MICROGLOCHIN, *Wahlenb.*; *Hook. f. l. c.* vi. 711 (misspelt Wall. there).

**1.** Tibet, 15,000–16,000 feet, *T. Thomson*. Ladak, *T. Thomson*. Dras, *Schlagintweit*, 6467. Kashmir: Musjid Vale, 12,000–13,000 feet, *Duthie*, 13203; Deosai, 13,000 feet, *C. B. Clarke*, 29826; Tilail, 12,250 feet, *C. B. Clarke*, 30653. Baltisthan, 13,000–14,000 feet, *Duthie*, 11, 973. Rondu, *Strachey & Winterbottom*. Jaunsar, 11,000 feet, *Rogers*. Kunawur, *Jacquemont*, 9.

*Distrib.* Cool parts of the North Hemisphere.

35. CAREX PARVA, *Nees*; *Hook. f. l. c.* vi. 712.

**1.** Kashmir: Barzil, *Winterbottom*, 635. Kunawur, *Jacquemont*, 1752. Mouru, *Royle*, 138. Tihri-Gurhwal, 11,000–12,000 feet, *Duthie*, 73.

**7.** Sikkim: Lachen, 12,000 feet, *J. H. Hooker*.

*Distrib.* Endemic.

36. CAREX LINEARIS, *Boott*; *Hook. f. l. c.* vi. 712.

**1.** West Himalaya, *Royle*. Kashmir: Tragbol, 11,400 feet, *C. B. Clarke*, 29266; Pir Pinjul, 11,000 feet, *H. C. Levinge*. Choor, 12,000 feet, *Edgeworth*. Kedarkanta, *Jacquemont*, 865. Gurhwal, 11,000 feet, *Strachey & Winterbottom*, Tihri-Gurhwal, 13,000–14,000 feet, *Duthie*, 376. West Nipal, 13,000–14,000 feet, *Duthie*, 6091 part.

**7.** Sikkim: Lachen, 13,000 feet, *J. D. Hooker*.

*Distrib.* Endemic.

CAREX LINEARIS, *Boott*:

Var. β. ELACHISTA, *C. B. Clarke in Hook. f. l. c.* vi. 713.

**1.** West Nepal, 13,000–14,000 feet, *Duthie*, 6091 part.

*Distrib.* Endemic. (One piece only.)

37. CAREX VIDUA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 713; *Boott MS.*

**7.** Sikkim: Lachen, 13,000 feet, *J. D. Hooker.*

*Distrib.* Endemic.

38. CAREX RARA, *Boott*; *Hook. f. l. c.* vi. 713.

**4.** Ceylon, *Gardner*, 950, *Thwaites*, 3080.

**7.** Bhotan, *Griffith*, 662, 1992, 2662, Kew n. 6096, 6102 part.

**8.** Khasia, *Griffith*, Kew n. 6102 part; Cherra Poonje, *Wallich*; Shillong, 6000 feet, *C. B. Clarke*, 43423.

*Distrib.* Japan. Borneo. Australia.

39. CAREX CAPILLACEA, *Boott*; *Hook. f. l. c.* vi. 713.

**7.** Sikkim; Lachen, 10,000–12,000 feet, *J. D. Hooker*; Yakla, 9000 feet, *C. B. Clarke*, 27846. Bhotan, *Griffith*, 2667, Kew n. 6095, 6101.

*Distrib.* Endemic? (if separable from *C. rara*).

40. CAREX CRYPTOSTACHYS, *Brongn. in Bot. Voy. Coquille*, p. 152, t. 25.

[*C. cyrtostachys*, C. B. Clarke in Hook. f. l. c. vi. 714, *errore.*]

**11.** Penang, *Wallich*, 3383. Perak, 3500 feet, hb. *King*, n. 8517. Singapore, *Ridley*, 1720.

*Distrib.* Malaya. China.

41. CAREX HELFERI, *Boeck.*; *Hook. f. l. c.* vi. 714.

**10.** Tenasserim River, in bamboo-jungle, *Helfer*, Kew n. 6111/2.

*Distrib.* Endemic.

42. CAREX PANDANOPHYLLA, *C. B. Clarke in Hook. f. l. c.* vi. 714.

**10.** Pegu, Yomah, *Kurz*, n. 2704.

*Distrib.* Endemic.

43. CAREX INDICA, *Linn.*; *Hook. f. l. c.* vi. 714.

**7.** Sikkim Terai, 500 feet, *C. B. Clarke*, 36996.

**8.** Cachar: Doodputli, *T. Thomson.* Chittagong: Kasalong, *C. B. Clarke*, 8265.

**10.** Tenasserim (or Andamans?), *Helfer*, Kew n. 6087 (marked by Boott's hand *C. fissilis*), Kew n. 6052 (marked by Boott's hand *C. indica*).

**11.** Penang, 700 feet, hb. *King*, 1496. Trang, *Kunstler*, 1383. Johore, *Luke & Kensall*, 4099.

*Distrib.* Cochinchina. Java.

CAREX INDICA, *Linn.*:

Var. ? β. LÆTE-BRUNEA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 715.

**4.** Ceylon, alt. 5000 feet, *Thwaites*, n. 2628 (marked by Boott's hand *C. bengalensis*, Roxb., and *C. Thwaitesii*).

**10.** Mergui, *Griffith*, 1011, Kew n. 6137 (young). Tenasserim, *Helfer*. R. Sáluen, *Wallich*, 3533.

**11.** Pahang, *Ridley*, n. 2145 (young). Kedah Peak, *Ridley*, 5147.

*Distrib.* Endemic.

CAREX INDICA, *Linn.*:

Var. MILNEI, *C. B. Clarke in Hook. f. l. c.* vi. 715.

**11.** Pahang, *Ridley*, 2143 *a*.

*Distrib.* Endemic.

44. CAREX DISTRACTA, *C. B. Clarke in Hook. f. l. c.* vi. 715.

**8.** Assam, "*Jenkins.*"

*Distrib.* Endemic.

There are two good sheets of this in hb. Kew, communicated by Col. Jenkins; doubtless obtained by the Calcutta Garden collectors who worked under him; without any note of habitat; both marked by Boott's hand *C. fissilis*, Boott. The example of Wall. Cat. 3421 "*Rynchospora* Napalia 1821" in hb. Kew is also *C. distracta*. The ticket is supposed erroneous; but whether it is so, or a mixture in the Wallichian herbarium, the number does not help us to the locality whence the plant was obtained: it may have been Nepal or Assam or elsewhere; the Wallich collections having been largely sorted (before the numbers were affixed).

45. CAREX CRUCIATA, *Wahlenb.*; *Hook. f. l. c.* vi. 715.

[**1.** Kumaon, *Wallich*, 3400 B part. Simla, *Fielding* (young).]

**7.** Nepal, *Lindley* (young). Darjeeling, 6000 feet, *C. B. Clarke*, 27291. Bhotan, 6000 feet, *Griffith*, Kew n. 6050; Lingling, *Griffith*, Kew n. 6051.

**8.** Khasia, *Griffith*, Kew n. 6049 (marked by Boott's hand *C. condensata*), *Griffith*, 29 (marked by Boott's hand *C. Bruceana*). Silhet, *J. D. Hooker*. Shillong, 5000 feet, *C. B. Clarke*, 37466. Jaintea Hills, *Bruce* (marked by Boott's hand *C. Bruceana*). Kohima, 4750 feet, *C. B. Clarke*, 41611.

**10.** Tenasserim, *Helfer*, Kew n. 6110.

**11.** Larut Perak, 300–600 feet, hb. *King*, 1906.

*Distrib.* China. Madagascar.

Wall. Cat. 3400 B contains several collections, different plants; and the *C. cruciata* plants in it were, I think, probably collected at Jowai by Gomez—though marked Kumaon.

CAREX CRUCIATA, *Wahlenb.* :

Var. NAGPORENSIS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 716.

**5.** Chota Nagpore; Parasnath, 3000 feet, *C. B. Clarke*, 21077, 21094; 4200 feet, *C. B. Clarke*, 33681; Singbhoom, 2000 feet, *C. B. Clarke*, 20445.

*Distrib.* Endemic.

CAREX CRUCIATA, *Wahlenb.* :

Var. ARGOCARPUS, *C. B. Clarke in Hook. f. l. c.* vi. 716.

**7.** East Nepal, 4000–6000 feet, Myong Valley and R. Tambur, *J. D. Hooker* (marked by Boott's hand *C. condensata*, Nees, but is figured in Boott, Carex, t. 241, as *C. bengalensis*). Darjeeling, *Griffith*, 7000 feet, *C. B. Clarke*, 26256, 2000 feet, *Treutler*; River (Rung) Ait, 2000 feet, *C. B. Clarke*, 10081; Mongpo, 4500 feet, *C. B. Clarke*, 36284.

**8.** Assam, *Mack* (marked by Boott's hand *C. bengalensis*); Brahmakhoond, *Griffith*, Kew n. 6098. Khasia, *Lemann* (figured, Boott, Carex, t. 242, as *C. bengalensis*); Bor Panee, *J. H. Hooker*, 4000–5000 feet, *C. B. Clarke*, 14718, 15586, 45614; Jowai, 3500 feet, *C. B. Clarke*, 44730.

*Distrib.* Tonkin.

I do not find, in Kew Herbarium, the green-fruited form of var. *argocarpus* stated, in Fl. Brit. Ind. 716, to have been collected on the Bruhmapootra bank (on the authority of Boott, which is certainly erroneous).

46. CAREX PARVIGLUMA, *C. B. Clarke in Hook. f. l. c.* vi. 716.

**8.** Luckimpore: Namsung, 1500 feet, *C. B. Clarke*, 37920, 37941, 37959.

*Distrib.* Endemic.

47. CAREX CONDENSATA, *Nees*; *Hook. f. l. c.* vi. 716.

**1.** West Himalaya, *Royle*, 83 (figured, Boott, Carex, t. 247), 23, 84, 85, 89. Sirmoor, Fagu, *Jacquemont*, 2334. Upper Sutledge, Rampur, *T. Thomson*. Kumaon, *Wall. Cat.*

3400 B part (figured, Boott, Carex, t. 245); Binsar, 7500 feet, *Strachey & Winterbottom*, *Madden*. Tihri-Gurhwal, 5000–6000 feet, *Duthie*, 374. Nepal, *Wallich*, 3400 *a*. Nepal, *Wallich* (marked by Boott's hand *C. vesiculosa*).

**2.** Sind, *Pinwill*.

**7.** Darjeeling, *Griffith*; Lachen, 10,000–11,000 feet, *J. D. Hooker*; Tonglo, 9000 feet, *C. B. Clarke*, 35041, 35686. Bhotan, *Griffith*, 2672.

**8.** Assam, *Mrs. Mack*. Khasia, *Griffith*; Cherra Poonjee, 4000 feet, *Gomez*, *J. D. Hooker*; Mamloo, 4000 feet, *C. B. Clarke*, 45093. Shillong, 4500–5000 feet, *C. B. Clarke*, 38498, 38879; Jowai, 3500 feet, *C. B. Clarke*, 44735.

*Distrib.* Endemic.

48. CAREX VESICULOSA, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 717.

**7.** Darjeeling, *Griffith*, Kew n. 6060; Goke, 2500 feet, *C. B. Clarke*, 24891; Tumlong, 3500 feet, *C. B. Clarke*, 27688. Bhotan, *Griffith*, 2676, 2678, Kew n. 6088.

**8.** Assam, *Griffith*, 986. Cherra Poonjee, *Griffith* (figured in Boott, Carex, t. 323), *Bruce*, *J. D. Hooker*; Mahadeo, *Griffith*, Kew n. 6057, 6058; Mamloo, 4000 feet, *C. B. Clarke*, 45431; Boga Pani, 4000 feet, *C. B. Clarke*, 44879. Khasia, 4000–5000 feet, *Hook. f. & T. Thoms.* East Bengal, *Griffith*, 364, Kew n. 6059, 6136.

*Distrib.* Endemic.

CAREX VESICULOSA, *Boott*:

Var. *β*. PANICULATA, *C. B. Clarke in Hook. f. l. c.* vi. 717.

**7.** Nepal, *Wallich*. Darjeeling, *Lemann*.

*Distrib.* Endemic.

49. CAREX CONTINUA, *C. B. Clarke in Hook. f. l. c.* vi. 717.

**7.** Nepal, *Wallich*, 3400 *a* part. Sikkim: River (Rung) Ait, 1100 feet, *C. B. Clarke*, 27136, 27142, 27241; River Teesta, 500 feet, *C. B. Clarke*, 26328.

*Distrib.* Endemic.

50. CAREX STRAMENTITIA, *Boeck.*; *Hook. f. l. c.* vi. 717.

**5.** Chota Nagpore: Parasnath, 4000 feet, *C. B. Clarke*, 34665.

**7.** Nepal, *Wallich*, 3398 (marked by Boott's hand *C. condensata*). Singaleh-la, 9000–12,000 feet, *Schlagintweit*, 14702. Sikkim: Darjeeling, *Griffith*, Kew n. 6138; 2000–4000 feet, Khursiong, *J. D. Hooker*; Choonbuttee, *C. B. Clarke*, 11990.

**8**. Assam, *Griffith*, 1490 (marked by Boott's hand *C. stramentitia*); Burney Hat, 500 feet, *C. B. Clarke*, 38081. Khasia: Nungpo, 2500 feet, *C. B. Clarke*, 43305; Myrung, *Simons*; 4000–5000 feet, *Hook. f. et T. Thoms.* Garo Hills: Rongrengiri, *C. B. Clarke*, 43037.

**9**. Mogoung Valley (Mines) and Patkoye Mts., *Griffith*, Kew n. 6056.

*Distrib.* Endemic.

51. CAREX FILICINA, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 717.

**3**. Nilgherry Mts., *Wight*, 1916, 1917, *Hohenacker*, 1290, 1291. Pulney Mts., *Wight*, 3176.

**4**. Ceylon, *Gardner*, n. 941, *Walker*, *Mackenzie*, *Thwaites*, n. 820.

**5**. Courtallum, *Wight*, 999, 1913. Palamcottah, *Wight*, 1294.

**8**. Assam, *Fielding*; Kohima, 5500 feet, *C. B. Clarke*, 41036. Khasia, 4000–5000 feet, *Hook. f. & T. Thoms.*; 1500–4500 feet, *C. B. Clarke*, 5392, 5521. Myrung, *J. D. Hooker* (Boott, Carex, t. 316). Surareen, *J. D. Hooker* (Boott, Carex, t. 313). Mauphlong and Maumbrai, *Griffith*, Kew n. 6053.

*Distrib.* China. Java.

CAREX FILICINA, *Nees*:

Var. β. MEIOGYNA, *Strachey*; *Hook. f. l. c.* vi. 718.

**1**. West Himalaya, *Royle*, 82, 86, 90, 4000–7000 feet, *Edgeworth* (Boott, Carex, t. 311). Kumaon, 6000 feet, *Strachey & Winterbottom*, n. 1 (Boott, Carex, t. 319). Kathi, 7200 feet, *Strachey & Winterbottom*, n. 3 (Boott, Carex, t. 317). Simla, Fagu, 8000 feet, *T. Thomson* (Boott; Carex, t. 312).

**2**. Sind, *Pinwill*.

**7**. Nepal, hb. *D. Don*. Sikkim, 4000–7000 feet, *J. D. Hooker*: Khursiong, *J. D. Hooker* (Boott, Carex, t. 320). Darjeeling, *Griffith*, Kew n. 6053; Lachen, 7000–9000 feet, *J. D. Hooker* (Boott, Carex, t. 314). Bhotan: Dumsong, 6000 feet, *C. B. Clarke*, 26424.

*Distrib.* Endemic.

CAREX FILICINA, *Nees* :

Var. γ. MINOR, *Boott* ; *Hook. f. Fl. Brit. Ind.* vi. 718.

**7.** Sikkim : Lachen, 7000–10,000 feet, *J. D. Hooker* (Boott, Carex, t. 318) ; Buckeem, 7500 feet, *C. B. Clarke*, 25317.

**8.** Khasia, 4000-6000 feet, *J. D. Hooker* ; Shillong Peak, 6400 feet, *C. B. Clarke*, 38707, 38719.

*Distrib.* Endemic.

CAREX FILICINA, *Nees* :

Var. δ. MICROGYNA, *C. B. Clarke in Hook. f. l. c.* vi. 718.

**3.** Malabaria, *Kurz*, 2695.

**4.** Ceylon, *Maxwell.*

**8.** Chittagong, *J. D. Hooker*, 269. Arracan : Boronga Island, *Kurz.*

*Distrib.* Endemic.

52. CAREX PLEBEIA, *C. B. Clarke in Hook. f. l. c.* vi. 718.

**5.** Chota Nagpore : Hazaribagh, 1750 feet, *C. B. Clarke*, 33841. Lohardugga, 2000 feet, *C. B. Clarke*, 33965, 33985. Singbhoom, 1500 feet, *C. B. Clarke*, 34125.

*Distrib.* Endemic.

53. CAREX LEPTOCARPUS, *C. B. Clarke in Hook. f. l. c.* vi. 719.

**9.** Muneypoor, *Watt*, 6728.

*Distrib.* Endemic.

54. CAREX MERCARENSIS, *Steud.* ; *Hook. f. l. c.* vi. 719.

**3.** Nilgherry Mts., *Wight*, 16, *Hohenacker*, 943, *Gough.* Ooty, 8000 feet, *C. B. Clarke*, 11097. Pulney Mts., *Wight*, 3172.

**5.** Madras, *J. D. Hooker* (Boott, Carex, t. 321). Courtallum, *Wight*, 998 (Boott, Carex, t. 322), 1293.

*Distrib.* Endemic.

CAREX MERCARENSIS, *Steud.* :

Var. β. MAJOR, *Steud.* ; *Hook. f. l. c.* vi. 719.

**3.** Bombay : Mahabelaishwar, *Woodrow*, 79. Canara : Mercara, *Hohenacker*, 629. Anamallay Mts., *Beddome.*

*Distrib.* Endemic.

55. CAREX RAPHIDOCARPA, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 719.
  **3.** Pulney Mts., *Wight*, 1911.
 *Distrib.* Endemic (only once collected).

56. CAREX CEYLANICA, *Boeck.*; *Hook. f. l. c.* vi. 719.
  **4.** Ceylon, 6000 feet, *Thwaites*, 820.
 *Distrib.* Endemic (apparently only once collected).

57. CAREX WIGHTIANA, *Nees*; *Hook. f. l. c.* vi. 720.
  **4.** Ceylon, *Walker* (a small doubtful piece).
  **5.** Coromandelia, *Wight*, 1914, 1915, Wall. Cat. 3400 C. Courtallum, *Wight*, 1292 (Boott, Carex, t. 30), 1296.
 *Distrib.* Endemic.

58. CAREX ECOSTATA, *C. B. Clarke in Hook. f. l. c.* vi. 720.
  **8.** Naga Hills: Jakpho, 9900 feet, *C. B. Clarke*, 41357, 41317.
 *Distrib.* Endemic.

59. CAREX REPANDA, *C. B. Clarke in Hook. f. l. c.* vi. 720.
  **8.** Khasia: Cherra, 3000 feet, *J. D. Hooker*; Mausmai, 4000 feet, *C. B. Clarke*, 14295. Shillong, 5200–5500 feet, *C. B. Clarke*, 43463, 44098.
 *Distrib.* Endemic.

60. CAREX PERAKENSIS, *C. B. Clarke in Hook. f. l. c.* vi. 720.
  **11.** Perak, *Wray*.
 *Distrib.* Endemic.

61. CAREX SANGUINEA, *Boott*; *Hook. f. l. c.* vi. 720.
  **1.** Murree Woods, *Fleming*, 184, 212.
 *Distrib.* Cabul.

62. CAREX RHIZOMATOSA, *Steud.*; *Hook. f. l. c.* vi. 721.
  **8.** Gowhatty, Brahmapootra Bank, *Booth*. Khasia, Nungpo, 2000 feet, *C. B. Clarke*, 43295. Thoyung, 3000 feet, *C. B. Clarke*, 37554.
  **9.** Muneypoor, 4000 feet, *Watt*, 6033. North of Ava, *Griffith*, Kew n. 6108, 6111.
 *Distrib.* Tonkin. Java. Philippines.

63. CAREX LINDLEYANA, *Nees*; *Hook. f. l. c.* vi. 721.
  **3.** Nilgherry Mts., *Wight*, 13, 14, 17 (Boott, Carex, t. 34),

*Gardner*, *Schmid.* Ooty, *Wight*, 2924; 8000 feet, *C. B. Clarke*, 11137.

**4**. Ceylon, *Walker*, 39, *Gardner*, 947; 7000 feet, *Thwaites*, 3161.

*Distrib.* Endemic.

64. CAREX LEUCANTHA, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 721.

**3**. Pulney Mts., *Wight*, 3174.

**4**. Ceylon, alt. 0–2000 feet, *Thwaites*, 2631, *Laube.*

**5**. Coromandelia, *Heyne*, *Wight*, 993, 998, 2379. Courtallum, *Wight*, 992.

*Distrib.* Endemic.

65. CAREX MALACCENSIS, *C. B. Clarke in Hook. f. l. c.* vi. 722.

**11**. Malacca: Langkawi, *Curtis*, 1669.

*Distrib.* Endemic.

66. CAREX SPICIGERA, *Nees*; *Hook. f. l. c.* vi. 722.

**4**. Central Province up to 6000 feet, *Thwaites*, 822; *Walker*, *Wight*, 1299, *W. H. Harvey.*

*Distrib.* Endemic.

CAREX SPICIGERA, *Nees*:

Var. β. MINOR, *Thwaites*; *Hook. f. l. c.* vi. 722.

**4**. Ceylon, *Gardner*, 949, *Thwaites*, 824.

*Distrib.* Endemic.

CAREX SPICIGERA, *Nees*:

Var. γ. RUBELLA (sp.), *Boott*; *Hook. f. l. c.* vi. 722.

**4**. Ceylon, alt. 7000 feet, *Thwaites*, 2966.

*Distrib.* Endemic.

CAREX SPICIGERA, *Nees*:

Var. δ. ROSTRATA, *Boeck.*; *Hook. f. l. c.* vi. 722.

**4**. Ceylon, *Thwaites*, 2629, fide *Boeck.*

*Distrib.* Endemic.

67. CAREX BACCANS, *Nees*; *Hook. f. l. c.* vi. 722.

**3**. Bombay, *Scott*, *Dalzell.* Bababoodun Hills, *Talbot*, 2337. Nilgiri Mts., *Gardner*, *Wight*, 6, 1912. Kotagherry, *Adam.* Pulney Mts., *Wight*, 3173.

**4**. Ceylon, *Maxwell*, *Walker*, *Wight*, 1290, 1298, *Gardner*, 943, *Thwaites*, 821.

**7**. East Nepal, *J. D. Hooker.* Sikkim, 4000–8000 feet, *J. D. Hooker.*

**8**. Assam, *Mack.* Khasia, 3000–5000 feet, Cherra and Ladder Hill, *J. D. Hooker*, 749; Maophlong, *Griffith*, Kew n. 6054; Mausmai, 4000 feet, *C. B. Clarke*, 45817. Naga Hills, 5800 feet, *C. B. Clarke*, 41151.

*Distrib.* China. Cochinchina. Malay Islands.

CAREX BACCANS, *Nees*:

Var. β. SICCIFRUCTUS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 723.

**8**. Khasia, *J. D. Hooker*; Umwai, 3500 feet, *C. B. Clarke*, 15868.

*Distrib.* Endemic.

68. CAREX MYOSURUS, *Nees*; *Hook. f. l. c.* vi. 723.

**3**. Nilgiri Mts., *Metz*, 942, *Wight*, 18. Canoor, 6000 feet *C. B. Clarke*, 10780. Pulney Mts., *Wight*, 3177. Dindygul, 2600 feet, *Wight*, *Wallich*, 3384 B.

**5**. Coromandelia, *Wight*, 1913. Courtallum, *Wight*, 1291, 1297.

*Distrib.* Endemic.

CAREX MYOSURUS, *Nees*:

Var. β. EMINENS (sp.), *Nees*; *Hook. f. l. c.* vi. p. 723.

**1**. Kashmir, 3000 feet (Basaoli), *C. B. Clarke*, 31628. Simla, 6000–7000 feet, *Edgeworth.* Gurhwal, 5000–6000 feet, *Duthie*, 4496. Tihri-Gurhwal, 3000–4000 feet, *Duthie*, 2118.

**7**. Nepal, *Wallich*, 3382, 3384 A. Gossain Than, *Wallich*, 3397. Darjeeling, *Griffith*, Kew n. 6055. Khursiong, 3000 feet, *C. B. Clarke*, 35895. Mintogong, 4500 feet, *C. B. Clarke*, 24938. Bhotan, *Griffith.*

*Distrib.* Endemic.

CAREX MYOSURUS, *Nees*:

Var. γ. RATONGENSIS, *C. B. Clarke in Hook. f. l. c.* vi. 723.

**7**. Sikkim: R. Ratong, 6000–8000 feet, *J. D. Hooker.*

*Distrib.* Endemic.

69. CAREX PRÆSTANS, *C. B. Clarke in Hook. f. l. c.* vi. 723.

**1**. Kumaon. 7000–8000 feet (above Shinkala), *Duthie*, 6118.

*Distrib.* Endemic.

70. CAREX SPICULATA, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 724.

**8.** Khasia: Cherra, *Wallich*, *Griffith*, Kew n. 6069, *J. D. Hooker*, 861; Shaila, 250 feet, *C. B. Clarke*, 14961; Kullong, 5700 feet, *C. B. Clarke*, 40043; Nurtiung, 4000–5000 feet, *Hooker f. & T. Thomson*; Amwee, 3000–4000 feet, *J. D. Hooker*.

*Distrib.* Endemic.

CAREX SPICULATA, *Boott*:

Var. *β*. NOBILIS (sp.), *Boott*; *Hook. f. l. c.* vi. 724.

**7.** Sikkim: Mongpo, 2000 feet, *C. B. Clarke*, 13777; R. Ryang, 1000 feet, *C. B. Clarke*, 13721, 13758; Punkabari, 1000 feet, *C. B. Clarke*, 13830.

**8.** Khasia: Mahadeo and Moosmai, *Griffith*, Kew n. 6085; 5000 feet, *Hooker f. et T. Thomson*; Cherra Khud, 2000 feet, *C. B. Clarke*, 41832; Nurtiung, 4000 feet, *Hooker f. et T. Thomson*; Jowai, 4000 feet, *C. B. Clarke*, 44751.

*Distrib.* Endemic.

71. CAREX COMPOSITA, *Boott*; *Hook. f. l. c.* vi. 724.

**7.** Mishmi; Premsong's, *Griffith*, 464, Kew n. 6080.

**8.** Assam, *Jenkins*. Khasia, *Griffith*, 4000–6000 feet, *Hooker et T. Thomson*; Cherra, *J. D. Hooker*; Kalapani, *J. D. Hooker*, 1354; Vale of Rocks, 5000 feet, *C. B. Clarke*, 45472; Boga Pani, 4000 feet, *C. B. Clarke*, 44878; Dingling, 5000 feet, *C. B. Clarke*, 18450; Shillong, 5300 feet, *C. B. Clarke*, 38363; Monai, 5000 feet, *C. B. Clarke*, 43991. Naga Hills, 5800 feet, *C. B. Clarke*, 41185.

**10.** Mergui, *Griffith*, 118.

*Distrib.* Endemic.

72. CAREX DESPONSA, *Boott*; *Hook. f. l. c.* vi. 724.

**8.** Khasia, alt. 5000–6000 feet, Moflong and Mairung Woods, *J. D. Hooker*, 1417.

*Distrib.* Endemic.

73. CAREX SCITULA, *Boott*; *Hook. f. l. c.* vi. 724.

**7.** Mishmi: Khosha's, *Griffith*, Kew n. 6097.

*Distrib.* Endemic.

74. CAREX INSIGNIS, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 725.

**7.** Nepal: Khabili R., 5000–6000 feet (near Sikkim), *J. D. Hooker*. Sikkim, 5000–7000 feet, *J. D. Hooker*; Khursiong, 7000 feet, *C. B. Clarke*, 35964. Bhotan: Sanal, 6500 feet, *Griffith*, Kew n. 6062.

**8.** Assam, *Jenkins*. Khasia: Kalapani, 4000–6000 feet, *Hooker f. et T. Thomson*; Myrung, *Griffith*, Kew n. 6061; Jowye, 4000 feet, *J. D. Hooker*.

*Distrib.* Endemic.

75. CAREX POLYCEPHALA, *Boott*; *Hook. f. l. c.* vi. 725.

**7.** Sikkim; Tonglo, 10,000 feet, *J. D. Hooker*; Tonglo, 8000 feet, *C. B. Clarke*, 35595; Dikeeling, 8000 feet, *C. B. Clarke*, 27875.

*Distrib.* Endemic.

76. CAREX WALKERI, *Boott*; *Hook. f. l. c.* vi. 725.

**3.** Nilgherries: Canoor, 6000–7500 feet, *C. B. Clarke*, 11002, 11033, 11065.

**4.** Ceylon, *Gardner*, 942; Pedrotalagalla, 7000 feet, *Thwaites*, 2751.

*Distrib.* Endemic.

77. CAREX DECORA, *Boott*; *Hook. f. l. c.* vi. 725.

**7.** Sikkim: Tonglo, 10,000 feet, *J. D. Hooker*; Tonglo, 9000 feet, *C. B. Clarke*, 35737; Sundukphoo, 10,000 feet, *C. B. Clarke*, 35673; Chola, 11,000–12,000 feet, *J. D. Hooker*.

**8.** Naga Hills: Pulinatadze, 7700 feet, *Prain* (not certainly identified).

*Distrib.* Endemic.

78. CAREX ARRIDENS, *C. B. Clarke in Hook. f. l. c.* vi. 726.

**10.** Nattoung, 4000 feet, *Kurz*.

**11.** Sarut Perah, 3000–3500 feet, hb. *King*, 2801.

*Distrib.* Endemic.

79. CAREX DALTONI, *Boott*; *Hook. f. l. c.* vi. 726.

**7.** Sikkim: Choongtam, 8000 feet, *J. D. Hooker*. Upper Sikkim, *Pantling*. Bhotan, *Griffith*, 2664, Kew n. 6086.

*Distrib.* Endemic.

80. CAREX INÆQUALIS, *C. B. Clarke*; *Hook. f. Fl. Brit. Ind.* vi. 726.

**1.** Kumaon, 8000–9000 feet, *Duthie*, 6114, 6117.

**7.** Sikkim: Lachen, 9000–11,000 feet, *J. D. Hooker.*

*Distrib.* Endemic.

81. CAREX WINTERBOTTOMI, *C. B. Clarke*; *Hook. f. l. c.* vi. 727.

**1.** Kumaon: Jugthana Pass, 8000 feet, *Strachey & Winterbottom*, 16.

*Distrib.* Endemic.

82. CAREX PULCHRA, *Boott*; *Hook. f. l. c.* vi. 727.

**7.** East Nepal: R. Tambur, *J. D. Hooker.* Sikkim: Lachen, 7000–11,000 feet, *J. D. Hooker.*

*Distrib.* Endemic.

83. CAREX MUNDA, *Boott*; *Hook. f. l. c.* vi. 727.

**7.** Sikkim: Lachen, 11,000–13,000 feet, *J. D. Hooker*: Jongri, 13,000 feet, *C. B. Clarke*, 26092. Sundukphoo, 12,000 feet, *C. B. Clarke*, 34988. North-east Sikkim, *Cummins.*

*Distrib.* Endemic.

84. CAREX STRACHEYI [*Duthie in*] *T. E. Atkinson, Gaz.* x. [1886?] p. 618; *Hook. f. Fl. Brit. Ind.* vi. 727.

**1.** Kumaon: Madhari Pass, 8000 feet, *Strachey & Winterbottom*, 18. Gurhwal: Kuari Pass, 12,000–13,000 feet, *Duthie*, 5000.

*Distrib.* Endemic.

85. CAREX CURVATA, *Boott*; *Hook. f. l. c.* vi. 728.

**7.** Sikkim: Lachen and Tungu, 12,000–13,000 feet, *J. D. Hooker.*

*Distrib.* Endemic.

86. CAREX INCLINIS, *C. B. Clarke in Hook. f. l. c.* vi. 728.

**7.** Sikkim: Lachen, 7000–13,000 feet, *J. D. Hooker*; Tonglo, 10,000 feet, *J. D. Hooker*; Sundukphoo, 12,000 feet, *C. B. Clarke*, 34992, 34994. Upper Sikkim, *Pantling.*

*Distrib.* Endemic.

87. CAREX FRAGILIS, *Boott*; *Hook. f. l. c.* vi. 728.

**7.** Sikkim: Lachen and Lachoong, 9000–11,000 feet, *J. D. Hooker.*

*Distrib.* Endemic.

88. CAREX MUNIPOORENSIS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 729.

**9.** Munipoor: Jopoo, 9500 feet, *Watt*, 6894, 7462.

*Distrib.* Endemic.

89. CAREX SPECIOSA, *Kunth*; *Hook. f. l. c.* vi. 729.

**3.** Kanara, 2000 feet, *Talbot*, 2282. Pulneys, *Wight*, 3175.

**5.** Madras Peninsula, *Wight*, 2380. Courtallum, *Wight*, 991. Rajmahl Hills, *Wallich*, 3391. Parasnath, 4200 feet, *C. B. Clarke*, 33783.

**7.** East Nepal: R. Khabili and R. Jwa, 4000–6000 feet, *J. D. Hooker*; R. Teesta, 1000 feet, *C. B. Clarke*, 11968.

**8.** East Bengal, *Griffith*, Kew n. 6100. Khasia, *Griffith*; Moflong, 5500 feet, *J. D. Hooker*, 2009. Vale of Rocks, 5000 feet, *C. B. Clarke*, 45214.

*Distrib.* Endemic.

90. CAREX RADICALIS, *Boott*; *Hook. f. l. c.* vi. 729.

**7.** Sikkim: Lachen, 10,000–11,000 feet, *J. D. Hooker*.

*Distrib.* Endemic.

91. CAREX CURTICEPS, *C. B. Clarke in Hook. f. l. c.* vi. 729.

**7.** Sikkim: Singalehah, 10,000–12,000 feet, *C. B. Clarke*, 13373, 25644. Sundukphoo, 12,000 feet, *C. B. Clarke*, 34985. North-east Sikkim, *Pantling*.

*Distrib.* Endemic.

92. CAREX ALPINA, *Swartz*; *Hook. f. l. c.* vi. 730.

**1.** Gilgit, 9000–10,000 feet, *Duthie*, 12404. Kishtwar, 10,000 feet, *T. Thomson*. Kashmir: Barzil, 10,500 feet, *C. B. Clarke*, 29617; Kunzlwan, 7500 feet, *C. B. Clarke*, 29352. Chini, *Jacquemont*, 466, 1357, 1560. Kunawur, *Royle*, 123. Kumaon, 14,000–15,000 feet, *Duthie*, 3468. Astore, *Strachey & Winterbottom*, 755. Garrys Valley, *Strachey & Winterbottom*, 4.

**2.** Kuram, 11,000 feet, *Aitchison*, 1243.

**7.** Sikkim: Yeumtong, 15,000 feet, *J. D. Hooker*.

*Distrib.* Cold North Hemisphere.

CAREX ALPINA, *Swartz*:

Var. β. EROSTRATA, *Boott*; *Hook. f. l. c.* vi. 730.

**1.** Kunawur, Lippa, *Royle*, 61. Tibet, 15,000 feet, *Strache & Winterbottom*, 1565.

*Distrib.* Endemic.

CAREX ALPINA, *Swartz*:

Var. γ. GRACILENTA, *Strachey*; *Hook. f. Fl. Brit. Ind.* vi. 730.

**1.** Kumaon, 10,000 feet, *Strachey & Winterbottom*, 675.

**7.** Sikkim: Lachen, 11,000–14,000 feet, *J. D. Hooker*.

*Distrib.* Endemic.

93. CAREX LEHMANNI, *Drejer*; *Hook. f. l. c.* vi. 730.

**1.** Tihri-Gurhwal, 11,000–12,000 feet, *Duthie*, 58. West Nepal, Nampa Gadh, 11,000–12,000 feet, *Duthie*, 6113. Nepal, *Wallich*, 3381.

**7.** Sikkim: Yeumtong, 12,000 feet, *J. D. Hooker*; Jongri, 13,000 feet, *C. B. Clarke*, 25818.

*Distrib.* Endemic.

94. CAREX OBSCURA, *Nees*; *Hook. f. l. c.* vi. 731.

**1.** Taranda, *Royle*, 118, 112 part; Shealkur, 9000 feet, *Munro*, 2442. Kashmir: Gulmurg, 9000–10,000 feet, *Duthie*, 11372. Kunawur, *Jacquemont*, 476. Kumaon: Rulam R., 10,500 feet, *Strachey & Winterbottom*, 1487.

**7.** Sikkim: Sundukphoo, 12,000 feet, *C. B. Clarke*, 34974.

*Distrib.* Endemic.

CAREX OBSCURA, *Nees*:

Var. β. BRACHYCARPA, *C. B. Clarke in Hook. f. l. c.* vi. 731.

**1.** West Himalaya, *Munro*, 2422. Simla, 9000–11,000 feet, *Browne*, 7382. Tihri-Gurhwal, 11,000–12,000 feet, *Duthie*, 61. West Nepal, 10,000–11,000 feet, *Duthie*, 6112.

**7.** Sikkim: Yeumtong, 12,000 feet, *J. D. Hooker*; Lachen and Kankola, 11,000–12,000 feet, *J. D. Hooker*; Putung-la, hb. *King*, 4407. North-east Sikkim, *Cummins*.

*Distrib.* Endemic.

95. CAREX ATRATA, *Linn.*; *Hook. f. l. c.* vi. 731.

**1.** Kashmir: Barzil, 11,300 feet, *C. B. Clarke*, 29722; Sonamurg, 11,000 feet, *W. S. Atkinson*. Sind Valley, 11,500 feet, *C. B. Clarke*, 31042.

**7.** Sikkim: Lachen and Tungu, 11,000–17,000 feet, *J. D. Hooker*; Tookoo-la, hb. *King*, 4339. North-east Sikkim, *Cummins*.

*Distrib.* Cold North Hemisphere.

96. CAREX DUTHIEI, *C. B. Clarke in Hook. f. l. c.* vi. 731.

**1.** Gurhwal: Bhowani, 13,000–14,000 feet, *Duthie*, 4499.

*Distrib.* Endemic.

CAREX DUTHIEI, *C. B. Clarke*:

Var. β. GLACIALIS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 732.

**7.** Sikkim: Momay, 15,000 feet, *J. D. Hooker*; Kankola, 15,000–17,000 feet, *J. D. Hooker*; Jongri, 13,000 feet, *C. B. Clarke*, 26161.

*Distrib.* Endemic.

97. CAREX NIVALIS, *Boott*; *Hook. f. l. c.* vi. 732.

**1.** Gilgit, *Giles*. Ladak and Nubra, 14,000–18,000 feet, *T. Thomson*. Tibet and Zanskar, 12,000–15,000 feet, *T. Thomson*. Parang Pass, *T. Thomson*. Karakorum, 13,000–14,000 feet, *C. B. Clarke*, 30235, 30244, 30439, 30441. Chinese Tartary, *Munro*, 2434. Dhunrao, 16,000 feet, *Edgeworth*. Kunawur, *Jacquemont*, 486, 15,000–16,000 feet, *T. Thomson*. Kashmir, 13,000–14,000 feet, *Duthie*, 13392, 13393, *Aitchison*, 114. Tibet, 15,000 feet, *Strachey & Winterbottom*, 23. Kumaon, *Strachey & Winterbottom*, 1565 part; Ralum Glacier, 13,000–14,000 feet, *Duthie*, 3469. Tihri-Gurhwal, 13,000–14,000 feet, *Duthie*, 371. Gurhwal, 10,500 feet, *Schlagintweit*, 10067.

**2.** Kuram, *Aitchison*, 1242.

**7.** Sikkim: Lachen and Samdung, 11,000–17,000 feet, *J. D. Hooker*.

*Distrib.* Cabul. Central Asia.

98. CAREX PSYCROPHILA, *Nees*; *Hook. f. l. c.* vi. 732.

**1.** West Himalaya, *Falconer*, 1165, *Royle*, 111. Kashmir: Gulmurg, 8000–9000 feet, *Duthie*, 11417; Sreenuggur, 7800 feet, *C. B. Clarke*, 29099. Zanskar, 8000–12,000 feet, *T. Thomson*. Kunawur, *Royle*, 124, 11,000 feet, *Brandis*. Karli, 5000–8000 feet, *Edgeworth*. Kedarkanto, *Royle*, 113. Simla, 9000–10,000 feet, *Duthie*, 7381. Tihri-Gurhwal, *Duthie*, 63 part. Kumaon, *T. Thomson*, 1112; Kishengunga, *Strachey & Winterbottom*, 602. Harung Ghat, 10,000–11,000 feet, *Munro*, 2424. Gurhwal, 10,000 feet, *Strachey & Winterbottom*, 1150. Nipal, *Wallich*, 3393.

**7.** Sikkim, Yeumtong, 12,000 feet, *J. D. Hooker*.

*Distrib.* Endemic.

99. CAREX MELANANTHA, *C. A. Meyer*; *Hook. f. l. c.* vi. 733.

**1** Gnari Khorsum, *Schlagintweit*, 7019. Kashmir: Baltisthan, 13,000–14,000 feet, *Duthie*, 12158; Liddar Valley, 13,000–14,000 feet, *Duthie*, 13360; Masjid Valley, 13,000 feet, *Duthie*, 13256; Barzil, 10,500 feet, *C. B. Clarke*, 29635; Zogi-la, 11,000 feet, *T. Thomson*; Sonamurg, 11,000 feet, *W. S. Atkinson*, *H. C. Levinge*, *C. B. Clarke*, 27351. Marbul Pass, 10,500 feet, *C. B. Clarke*, 31290. Lahoul, *Jaeschke*, 123 *a*.

***Distrib.*** Cabul. Central Asia.

100. CAREX MOORCROFTII, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 733.

**1.** Tibet, 17,600 feet, *Thorold*, 25; Rockhill, 15,000 feet, *Strachey & Winterbottom*, 13, *Falconer*, *Lance*, 288. Karakorum, 14,000 feet, *Conway*; Baltisthan, 12,000–13,000 feet, *Duthie*, 11942; Karakash, *Cayley*; Lanak Pass and Parang Valley, 12,000–16,000 feet, *T. Thomson*. Kunawur, *Jacquemont*, 1752, 1829. Piti, *Jacquemont*, 1957. Spiti, *Schlagintweit*, 2538. Lahoul, *Schlagintweit*, 4127.

**7.** Sikkim, Kiangza and Bomtso, 16,000–17,000 feet, *J. D. Hooker*. Pharee, *Dunboo*.

***Distrib.*** Central Asia.

101. CAREX SUPINA, *Wahlenb.*; *Hook. f. l. c.* vi. 733.

**1.** Kumaon: Bugdwar, *Strachey & Winterbottom*, 17; Jalinka, 14,000–15,000 feet, *Duthie*, 6098.

***Distrib.*** Central Asia. Arctic Europe.

102. CAREX USTULATA, *Wahlenb.*; *Hook. f. l. c.* vi. 734.

**1.** Tibet, 17,200 feet, *Strachey & Winterbottom*, 1742; 16,500 feet, *Littledale*. Nubra, 15,000–17,000 feet, *T. Thomson*; Hanle and Sonamurg, *T. Thomson*. Kunawur, *Jacquemont*, 1823. Nepal, *Wallich*; Nampa Gadh, 13,000–14,000 feet, *Duthie*, 6109.

**7.** Sikkim: Momay, 17,000 feet, *J. D. Hooker*; Yeumtong, 15,000 feet, *J. D. Hooker*; Tungu, 12,000–13,000 feet, *J. D. Hooker*.

*Distrib.* Cold North Hemisphere.

[*C. macrantha*, Boeck. Cyp. Novæ, Heft 1 [1888], p. 49, was this species.]

103. CAREX CRUENTA, *Nees*; *Hook. f. l. c.* vi. 734.

**1.** Gilgit, *Giles*, 121. Tibet: Kishengunja, 15,000 feet, *Strachey & Winterbottom*, 601; Barzil, 15,000 feet, *Strachey & Winterbottom*, 615, 616. Kashmir: Kishtwar, 8000–14,000 feet, *T. Thomson*; Rembiana Valley, 8000 feet, *C. B. Clarke*, 27350. Sind Valley, *Jacquemont*, 988; 10,000–11,000 feet, *Duthie*, 11622. [Kunawur], *Jacquemont*, 492, 502. Zanskar, *T. Thomson*. Tihri-Gurhwal, 11,000 feet, *Duthie*, 59. Gurhwal, 15,000 feet, *Strachey & Winterbottom*, 24, 25. Kumaon, *Wallich*, 3389 B.

**7.** Gosain Than, *Wallich*, 3389 A. Sikkim, Lachen, 13,000 feet, *J. D. Hooker*.

*Distrib.* Central Asia.

[*C. heterolepis*, Boeck. Cyp. Novæ, Heft 1 [1888], p. 48, *non Boott*, was this species.]

104. CAREX MACULATA, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 735.

**3.** Nilgiris, *Wight*; Canoor, 5000–7000 feet, *C. B. Clarke*, 10887, 10960.

**4.** Ceylon, *Walker*, *Gardner*, 944 part, *Thwaites*, 2630.

**8.** East Bengal, *Griffith*, Kew n. 6065. Khasia, *Griffith*; Mausmai and Cherra Coalhill, 3750–4200 feet, *C.B.Clarke*, 43722, 43848.

*Distrib.* Korea. Japan. Australia.

105. CAREX VICINALIS, *Boott*; *Hook. f. l. c.* vi. 735.

**3.** Nilgiris, *Schmidt*.

*Distrib.* Endemic.

106. CAREX JACKIANA, *Boott*; *Hook f. l. c.* vi. 735.

**8.** East Bengal, *Griffith*, Kew n. 6090. Khasia, *Griffith*, 6000 feet, *Hooker f. & T. Thomson*; 4000 feet, *J. D. Hooker*, 1015; Shillong, 6000 feet, *C. B. Clarke*, 43435; Mausmai to Cherra Coalhill, 3750–4200 feet, *C. B. Clarke*, 43726, 43850.

*Distrib.* Java. Japan.

CAREX JACKIANA, *Boott*:

Var. β. MINOR, *C. B. Clarke in Hook. f. l. c.* vi. 735.

**3.** Nilgiri Mts., Canoor, 7000 feet, *C. B. Clarke*, 11061.

**4.** Ceylon, 5000 feet, *Thwaites*, 3198.

*Distrib.* Endemic.

107. CAREX FUSIFORMIS, *Nees*; *Hook. f. l. c.* vi. 736.

**1.** Mussoorie, *Royle*, 88. Kumaon, Binsar, 7000 feet, *Strachey & Winterbottom*, 10.

**7.** Sikkim: Lachen, 10,000–12,000 feet, *J. D. Hooker*.

*Distrib.* Endemic.

108. CAREX FINITIMA, *Boott*; *Hook. f. Fl. Brit. Ind.* vi. 736.

**7.** Sikkim: Lachen, 10,000–12,000 feet, *J. D. Hooker*; Tonglo Top, 10,000 feet, *J. D. Hooker*; Tonglo, 9000 feet, *C. B. Clarke*, 27406, 35026; Suudukphoo, 10,000 feet, *C. B. Clarke*, 35059.

*Distrib.* Endemic.

CAREX FINITIMA, *Boott*:

Var. β. ATTENUATA, *C. B. Clarke in Hook. f. l. c.* vi. 736.

**8.** Khasia: Vale of Rocks, 4500 feet, *C. B. Clarke*, 43675.

*Distrib.* Endemic.

109. CAREX BREVISCAPA, *C. B. Clarke in Hook. f. l. c.* vi. 736.

**4.** Ambagamowa, *Thwaites*, 3781.

*Distrib.* Endemic.

110. CAREX JAPONICA, *Thunb.*; *Hook. f. l. c.* vi. 736.

**7.** Nepal, *Wall. Cat.* 3395 part. Darjeeling, *Griffith*, Kew n. 6079.

**8.** Khasia: Shillong Hills, 5500 feet, *C. B. Clarke*, 43451, 43461; Soor Pahar, 6000 feet, *C. B. Clarke*, 43656.

*Distrib.* Japan.

I think it quite possible, from the general state of the present numbering of Wallich's and of Griffith's collections, that the pieces of this plant ticketed "Nepal," "Darjeeling," respectively may have been collected in Khasia.

CAREX JAPONICA, *Thunb.*:

Var. β. ALOPECUROIDES, *C. B. Clarke in Hook. f. l. c.* vi. 737.

**7.** Nepal, *Wallich*, n. 3395 partly. Darjeeling, *Griffith*. Sikkim: Lachung, 6000 feet, *J. D. Hooker*; Rungait, 1000 feet, *J. D. Hooker*.

**8.** Khasia: Nunklao, 3750 feet, *J. D. Hooker*, *C. B. Clarke*, 44049.

**9.** Muneypoor: Keyang, 8400 feet, *Watt*, 6710.

*Distrib.* Japan.

111. CAREX DILUTA, *Bieb.*; *Hook. f. l. c.* vi. 737.

**1.** Baltisthan, 8000 feet, Skardo to Dras, *C. B. Clarke*, 29966, 30511; Shigar, *C. B. Clarke*, 30078.

**2.** Beloochisthan, *Stocks*.

*Distrib.* Cabul and Central Asia to Lapland and the Azores.

[*C. Aitchisoni*, Boeck. in Flora, lxiii. [1880], p. 456, was this species.]

112. CAREX MUNROI, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 738.

**1.** Kunawur: Nako, 11,500 feet, *Munro*, 2431.

*Distrib.* Endemic.

113. CAREX FERRUGINEA, *Scop.*; *Hook. f. l. c.* vi. 738.

**1.** Kashmir: Pir Pinjul, 11,000 feet, *C. B. Clarke*, 28773.

*Distrib.* Central Asia and Alpine Europe.

114. CAREX TRISTIS, *Bieb.*; *Hook. f. l. c.* vi. 738.

**1.** Karakorum, 14,500 feet, *C. B. Clarke*, 30224. Kashmir: Burji-la, 13,000–14,000 feet, *C. B. Clarke*, 29837, 29863; Dras, 11,000–12,000 feet, *Duthie*, 13797; Liddar Valley, 13,000 feet, *Duthie*, 13390.

*Distrib.* Central Asia.

115. CAREX FLAVA, *Linn.*; *Hook. f. l. c.* vi. 739.

**1.** Kashmir: Ramu, *Jacquemont*, 436; 6000 feet, *C. B. Clarke*, 28492; Dras, 11,000 feet, *T. Thomson*; Gurais, 8000 feet, *C. B. Clarke*, 29493.

*Distrib.* North Temperate Regions. [There are examples of *C. flava*, or at least of closely-allied forms marked by Boott or other competent men *C. flava*, from Tasmania, South Africa, Temperate South America.]

116. CAREX SONGORICA, *Karel. et Kiril.*; *Hook. f. l. c.* vi. 739.

**1.** Kashmir: Gurais to Barzil, 8000–9000 feet, *C. B. Clarke*, 29484, 29605; Dras, 10,000–11,000 feet, *Duthie*, 13702.

**2.** Kuram, *Aitchison*, 602.

*Distrib.* Cabul. Central Asia. Mandschuria. (But will be much wider if the plant be esteemed a Var. of *C. nutans*, Host.)

117. CAREX ROSTRATA, *Stokes*; *Hook. f. l. c.* vi. 740.

**1.** Kashmir, *Jacquemont*, 1024; Dras, 10,000–11,000 feet, *Duthie*, 11728, 13696, 13868; Zogi-la, 11,000 feet, *T. Thomson*; Deosai, 13,500 feet, *C. B. Clarke*, 29822; Gurais, 8000 feet, *C. B. Clarke*, 29484. Lahoul, *Jaeschke*, 123. Kishengunga, *Strachey*, 603. Kumaon: Kutti Yangti, 15,000 feet, *Duthie*, 6107.

**7.** Sikkim: Lachen, 9000–12,000 feet, *J. D. Hooker.* Bhotan, *Griffith*, 2665.

*Distrib.* Cool Northern Regions.

118. Carex vesicaria, *Linn.*; *Hook. f. Fl. Brit. Ind.* vi. 740.

**1.** Kashmir: Margan Pass, 11,500 feet, *W. S. Atkinson.*

*Distrib.* Cool Northern Regions.

119. Carex Pseudo-cyperus, *Linn.*; *Hook. f. l. c.* vi. 740.

**1.** Kashmir, 6000 feet, *T. Thomson*; Pir Pinjul, 11,000 feet, *H. C. Levinge.*

*Distrib.* Cool Northern Regions. [There are examples from Temperate South America, and from the Cape, considered this species by competent men.]

120. Carex acutiformis, *Ehrh.*; *Hook. f. l. c.* vi. 740.

**1.** Kashmir: Ganderbal, 6000 feet, *T. Thomson.* Lahoul, *Jaeschke*, 277 part.

*Distrib.* Cool Northern Regions.

121. Carex tumida, *Boott*: *Hook. f. l. c.* vi. 741.

**7.** Sikkim, 8000–10,000 feet, *J. D. Hooker*; Khursiong, 6000 feet, *C. B. Clarke*, 26, 662.

**8.** Khasia: Shillong, 6000 feet, *C. B. Clarke*, 43392.

*Distrib.* Endemic.

122. Carex olivacea, *Boott*; *Hook. f. l. c.* vi. 741.

**7.** Sikkim, 1000–2000 feet, *J. D. Hooker.*

**8.** Assam, *Jenkins*, *Masters*; Luckimpore, 300 feet, *C. B. Clarke*, 37846; Kamroop, 1000 feet, *C. B. Clarke*, 43251. Cachar, *Keenan.*

*Distrib.* Java. Japan.

123. Carex lobulirostris, *Drejer*; *Hook. f. l. c.* vi. 741.

**4.** Ceylon, *Walker*, *Wight*, 1296, *Gardner*, 946; 6000–7000 feet, *Thwaites*, 2633.

*Distrib.* Endemic.

124. Carex lurida, *C. B. Clarke in Hook. f. l. c.* vi. 742.

**7.** Sikkim: Lachen, 8000–12,000 feet, *J. D. Hooker.* Bhotan: Chupcha, 8000 feet, *Griffith*, 1067, Kew n. 6066.

*Distrib.* Endemic.

125. CAREX FUSCIFRUCTUS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 742.

**8.** Luckimpore: Makum, 300 feet, *C. B. Clarke*, 37814.

*Distrib.* Endemic.

126. CAREX FLACCA, *Schreb.*; *Hook. f. l. c.* vi. 742.

**2.** Sind, *Pinwill.*

*Distrib.* Temperate North Hemisphere.

127. CAREX SETIGERA, *D. Don*; *Hook. f. l. c.* vi. 743.

**1.** Kashmir: R. Banahal and Badarwar, *T. Thomson.* Kunawur, *Jacquemont*, 1207. Pangi, *T. Thomson.* North-west Himalaya, *Royle*, 143; Topa, *Hill*, *Fleming*; Mussoorie, *Jameson*, *Jacquemont*, 491. Naini Tal, *T. Thomson*, 534 part, *Strachey & Winterbottom*, 204. Nepal, *Wallich*, 3385.

**7.** Sikkim: Choongtam, 7000 feet, *J. D. Hooker*; Lachen, 8000 feet, *J. D. Hooker.* Firkit, *King's Collector.*

*Distrib.* Endemic.

128. CAREX SCHLAGINTWEITIANA, *Boeck.*; *Hook. f. l. c.* vi. 743.

**1.** Kashmir: Ruttun Pir, 7000 feet, *C. B. Clarke*, 28365. North-west Himalaya, *T. Thomson.* Jummoo, 8000 feet, *Brandis.* Kunawur, 10,000 feet, *Brandis.* Simla, 6000–7000 feet, *Schlagintweit*, 5039, *Brandis.*

**2.** Sind, *Pinwill.*

*Distrib.* Yarkand.

129. CAREX INANIS, *Kunth*; *Hook. f. l. c.* vi. 743.

**1.** Kashmir: Ruttun Pir, 7000 feet, *C. B. Clarke*, 28369. Simla, *Jacquemont*, 961; Fagu, *T. Thomson.* Tihri-Gurhwal, 9000–10,000 feet, *Duthie*, 63. Gurhwal, *T. Thomson*, 534 part. Kedarkanta, *Royle*, 131. Naini Tal, 6400 feet, *Strachey & Winterbottom*, 15. Kumaon, 7000–8000 feet, *Duthie*, 3467, 11,000 feet, *Duthie*, 6099.

**7.** Sikkim, 8600 feet, *Treutler*, 430; Lachen and Yangma Guola, 7000–13,000 feet, *J. D. Hooker*; R. Kulhait, 7000 feet, *C. B. Clarke*, 12993; Tumbok, 10,000 feet, *C. B. Clarke*, 12892.

*Distrib.* Endemic.

130. CAREX KASHMIRENSIS, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* vi. 743.

**1.** Kashmir: Pir Pinjul, *Jacquemont*, 559. Kishtwar, 15,000 feet, *T. Thomson.* Sind Valley, 11,500 feet, *C. B. Clarke*, 31036, 31039; Tragbol, 10,200 feet, *C. B. Clarke*, 29223; Goorais, 10,000 feet, *C. B. Clarke*, 29281.

*Distrib.* Endemic.

131. CAREX HÆMATOSTOMA, *Nees*; *Hook. f. l. c.* vi. 744.

**1.** Nubra, 15,000–17,000 feet, *T. Thomson.* Kashmir: Liddar Valley, 13,000–14,000 feet, *Duthie*, 13359; Baltal, *T. Thomson.* Kunawur, *Jacquemont*, 1541, *Royle*, 116, *T. Thomson*, 2035. Chinese Tartary, 7000–9000 feet, *Munro*, 2441. Kumaon, *Strachey & Winterbottom*, 9; 13,000-14,000 feet, *Duthie*, 3470.

**7.** Sikkim: Lachen and Yeumtung, 11,000–13,000 feet, *J. D. Hooker*; Phalung and Samding, 16,000–17,000 feet, *J. D. Hooker*; Jongri, 13,000 feet, *C. B. Clarke*, 25781. Chumbi, *King's Collector.*

*Distrib.* Central Asia.

132. CAREX HIRTELLA, *Drejer*; *Hook. f. l. c.* vi. 744.

**1.** Skardo: ascent to Deosai, *Strachey & Winterbottom*, 863, 864. Kashmir: Pir Pinjul, *Jacquemont*, 554; Margan Pass, 9500 feet, *W. S. Atkinson*; Kishtwar, 15,000 feet, *T. Thomson*; Tilail, 12,500 feet, *C. B. Clarke*, 30660. Chumba: Sauch Pass, *T. Thomson.* Kunawur, *Jacquemont*, 1415, *Royle*, 120, 122. Tihri-Gurhwal, 9000–10,000 feet, *Duthie*, 62.

**2.** Kuram Valley, 11,000 feet, *Aitchison*, 1007.

*Distrib.* Endemic.

133. CAREX CARDIOLEPIS, *Nees*; *Hook. f. l. c.* vi. 744.

**1.** Kashmir, *Falconer*, 1163; Islamabad to R. Banahal, 8000–10,000 feet, *T. Thomson*; Alibad, 10,000-11,000 feet, *C. B. Clarke*, 28919, 28953; Tihri-Gurhwal, 8000-9000 feet, *Duthie*, 3,3; Sirmoor, *Jacquemont*, 961; Surkunda, 9000–10,000 feet, *Edgeworth*; Mussoorie, *Royle*, 146, 10,000 feet, *Munro*, 2430, *Duthie*, 2119. Kumaon, 10,000 feet, *Strachey & Winterbottom*, 8.

**2.** Kuram, *Aitchison*, 418, 1244.

*Distrib.* Cabul.

134. Carex Halleriana, *Asso*; *Hook. f. Fl. Brit. Ind.* vi. 745.
  **2.** Sind, *Pinwill.*

*Distrib.* From Cabul to Central Europe. Also (a subspecies) in North America.

135. Carex læta, *Boott*; *Hook. f. l. c.* vi. 745.
  **7.** Sikkim: Tungu, 12,000–13,000 feet, *J. D. Hooker.*

*Distrib.* Endemic.

136. Carex setosa, *Boott*; *Hook. f. l. c.* vi. 745.
  **1.** Kashmir: Sind Valley, 12,000 feet, *C. B. Clarke*, 30994; Pir Pinjul, 11,000 feet, *C. B. Clarke*, 28883. Tihri-Gurhwal, 10,000–12,000 feet, *Duthie*, 56, 60.
  **7.** Sikkim: Lachen, 9000–12,000 feet, *J. D. Hooker.* Namdee, 12,000 feet, *Pantling.*

*Distrib.* Endemic.

137. Carex oligocarpa, *C. B. Clarke in Hook. f. l. c.* vi. 746.
  **1.** Karakorum, 12,750 feet, *C. B. Clarke*, 30436. Dras-Skardo, 12,500 feet, *C. B. Clarke*, 30533.

*Distrib.* Endemic.

138. Carex breviculmis, *R. Br.*; *Hook. f. l. c.* vi. 746.
  **1.** Mussoorie, *Royle*, 152, 6000 feet, *Munro*, 2428. Simla, 9000–10,000 feet, *Duthie*, 7383. Kumaon, 7000 feet, *T. Thomson.*
  **2.** Sind, *Pinwill.*
  **3.** Nilgherries: Canoor, 7000 feet, *C. B. Clarke*, 10830.
  **8.** Khasia: Shillong, 5000–5600 feet, *C. B. Clarke*, 43616, 44092; Vale of Rocks, 4500 feet, *C. B. Clarke*, 43700.
  **9.** Muneypoor: Khongui, 6000 feet, *Watt*, 6341.

*Distrib.* Japan. China. Australia. New Zealand.

139. Carex nemostachys, *Steud.*; *Hook. f. l. c.* vi. 746.
  **8.** Khasia: Myrung, *Griffith*, 1256, Kew n. 6078, *J. D. Hooker*, 1939; Kalapani, 5000–6000 feet, *J. D. Hooker*; Nongkrem, *J. D. Hooker*, 2245; Moflong, *J. D. Hooker*; Nurtiung, *J. D. Hooker.* Garo Hills, Suwangiri, 1200 feet, *C. B. Clarke*, 42984.

*Distrib.* China. Japan.

140. CAREX WALLICHIANA, *Nees*; *Hook. f. Fl. Brit. Ind.* vi. 747.

1. Kashmir: Oolar Lake, *Strachey & Winterbottom*; Naoshera, *Jacquemont*, 333; Rawul Pindee, *Aitchison*, 1127. North-west Himalaya, *Royle*, 114. Dehra Dhoon, *King*. Kumaon, *Munro*, 2421; 1500 feet, *Strachey & Winterbottom*.
2. Jullundur, 900 feet, *T. Thomson*. Sind, *Pinwill*. Oudh Terai, *Wallich*, 3380.
6. Saharunpore, *Jacquemont*. Moradabad, *T. Thomson*, 464. Delhi Canal, *Edgeworth*.
7. Nepal, *Wallich*, 3379. Tonglo, *Lister*.
8. Jorhaut, *Griffith*; Gowhatti, *Booth*. Cachar, *Keenan*.
9. Wulloboon, *Griffith*, 22, Kew n. 6071.

*Distrib.* Cabul.

141. CAREX LIGULATA, *Nees*; *Hook. f. l. c.* vi. 747.

1. Kashmir, *Falconer*, 1164. Mussoorie, *Royle*, 115. Kumaon, 7000 feet, *Strachey & Winterbottom*, 1934; Ranikhet, 5000–6000 feet. *Duthie*, 6119.
3. Nilgherries: Canoor, 5000–7000 feet, *C. B. Clarke*, 10826, 10888.
4. Peradenia, *Thwaites*, 2750.
7. Nepal: R. Khabili, *J. D. Hooker*.
8. Khasia: Shillong, 6000 feet, *C. B. Clarke*, 38688.

*Distrib.* China. Japan.

142. CAREX HEBECARPA, *C. A. Meyer*; *Hook. f. l. c.* vi. 747.

7. Nepal, *Wallich*, 3379.
9. Muneypoor: Karong & Moa, 4000–5800 feet, *C. B. Clarke*, 41779, 4200.

*Distrib.* Endemic.

A REX HEBECARPA, *C. A. Meyer*:

Var. β. LACHNOSPERMA, *C. B. Clarke in Hook. f. l. c.* vi. 747.

7. Nepal: R. Khabili, 5000–6000 feet, *J. D. Hooker*.
8. Khasia, *Griffith*, Kew n. 6063; Nunklao, 5000–6000 feet, *J. D. Hooker*, 1830.

*Distrib.* Cochinchina.

## CONCLUSIONS.

### NOTE (A). *On the Distribution of the Sub-Order* Mapanieæ *in India.*

The whole material that has come through my hands from the herbaria is only 114 collections, representing 22 closely-allied species. Nevertheless, much may be proved by this scanty material; for the plants are large or striking, and if they are not collected while obscure *Scirpus*, *Fimbristylis*, are collected in abundance, we may assume that the individuals of Mapaniæ are not numerous and that they are in very narrow localities.

[The whole sub-order lies between 27° N. L. and 27° S. L. in both hemispheres *except* the distinct genera *Chrysothrix* at the Cape and *Chorisandra* in Cape Town.]

The two large genera *Mapania* and *Hypolytrum* occur in America, Africa, Asia, and Oceania, and are concomitant everywhere (remarkable if the view of Pax of their wide separation is correct): thus, in India there is a cluster of *Hypolytrum* in Ceylon, also of *Mapania*; there is a cluster of *Hypolytrum* down the Malay Peninsula to Singapore, also of *Mapania*. The two genera are similarly linked in the American distribution, the centre of gravity for both being in Guiana and Lower Amazon.

The actual Indian distribution is (1) Ceylon (South and West), continued up the Malabar Ghats to Bombay. (2) Singapore and Malay Peninsula, continued up through Pegu and Chittagong to the Bruhmapootra—with one species in Sikkim.

### NOTE (B). *The Geographic Distribution of the* Caricineæ *of India.*

The Caricineæ are especially worth attention in their geographic distribution, because they are strictly indigenous; of the 1117 examples above tabulated, there is perhaps not one that was not truly wild. Of *Cyperus*, *Fimbristylis*, &c., huge quantities of many species are cultivated by man with his corn; of *Kobresia* and *Carex* I know no cornfield weed or species that accompanies man in any way.

In order to shorten the present article, the Indian Caricineæ are arranged in three groups, viz.:—(1) *Propriæ, i. e.* the sect. *Propriæ* of *Eu-Carex*, the few closely-allied sect. *Atratæ* being thrown in; (2) the sect. *Indicæ* of *Eu-Carex*; (3) the remainder of Caricineæ, being mainly *Vignea* (with *Kobresia* and the few species of *Eu-Carex* sect. 4. *Raræ* thrown in). The species then number (a very few strongly marked forms being treated as species):—

| | Non-Endemic. | Endemic. | Total. |
|---|---|---|---|
| *Propriæ* | 32 | 20 | 52 |
| *Indicæ* | 7 | 46 | 53 |
| *Vignea*, &c. | 25 | 32 | 57 |
| | 64 | 98 | 162 |

The Nilghiri Hills with the Mountains of Ceylon, and much intermediate mountainous and jungly country as Travancore, Anamallays, Pulneys, Courtallum will be referred to as the Nilghiri-Ceylon Region. The whole hilly and jungly region from Khasia to Singapore will be referred to as the Eastern Region.

The component parts of the Non-Endemic Indian Caricineæ will be arranged as the European component, the Central-Asian, the Eastern.

Beginning with the Non-Endemic *Propriæ*,—we find that, of the 32 species, 14 belong to the "European component"—they enter India at the North-west corner and occupy the higher levels, 8000–12,000 feet, of our West Himalayan subsubarea; *they extend no farther into India*, only one or two of them have been collected in Upper Sikkim. These are species of Cooler (Northern and Alpine) Europe which have nearly all been found in the Caucasus and intermediate regions; many of these West Himalayan species reach England (as *C. flava*, Linn., *C. rostrata*, Stokes, *C. vesicaria*, Linn., *C. acutiformis*, Ehrh., *C. Pseudo-cyperus*, Linn.). The somewhat isolated *C. Wallichiana*, Nees, extends from Cabul to Ava; but of the preceding European-component 14, not one reaches Khasia, far less does any one execute the jump to Malabaria.

The Central-Asian component of the Non-Endemic *Propriæ*, of 8 species only, reaches only the high Himalaya, 10,000–16,000 feet: it is a component of the Indian flora merely because we extend our political north frontier of India into the high plateau of Central Asia.

The Eastern component of the Non-Endemic *Propriæ* contains 9 species also found in China, Japan, or Malaya; with one very widespread species, *C. breviculmis*, R. Br., which is scattered from New Zealand and Japan to the West Himalaya. Of this Eastern component we find that 4 species inhabit Khasia and also the Nilghiri-Ceylon region, being absent in the directly intervening area of Bengal, Central India, &c. (1000 miles). It is suggested below that the Eastern component which reappears so strongly in the Nilghiri-Ceylon region came *viâ* Sumatra.

The Endemic *Propriæ* emphasizes what the Non-Endemic teach us of Geography: of the 20 species 12 are high-level West Himalayan, 5 are included between Sikkim and East Assam, 3 are of Nilghiri-Ceylon.

The component parts of the *Indicæ* will be considered under the same heads as the *Propriæ*.

As to the Non-Endemic 7 species, 5 belong to the Eastern component, and of these 3 also occur in the Nilghiri-Ceylon region. One of these latter, *C. baccans*, Nees, creeps up the Malabar Ghats northwards; I have seen two examples labelled "Bombay," but am not sure how near Bombay town these were got.

As to the remaining two Non-Endemic *Indicæ*, one is the rare *C. sanguinea*, Boott, of which I have seen two examples only—(*a*) from the Murree woods; (*b*) from Cabul; the other is the *C. cruciata*, Wahlenb., a species (as understood in the 'Flora of British India') scattered from Madagascar to China; but both itself and its varieties are so difficult to define botanically, that I do not think it safe to draw any deductions from its area of habitation.

The Endemic *Indicæ* are 46: of these 17 are in Sikkim or West Himalaya or both (mostly at temperate levels); 17 are in Sikkim or Assam or both; 9 are in the Nilghiri-Ceylon region, whereof *C. mercarensis* extends north up the Malabar Ghats nearly to Bombay. The remaining 3 endemic species have more unusual areas of habitation:—*C. plebeia* grows at the 1500–2000 level throughout Chota Nagpore; it is so closely allied to the abundant *C. filicina*, Nees, that it might be reckoned the Chota Nagpore geographic race of that species; *C. stramentitia*, Boeck., plentiful in the East Himalaya and Assam, occurs also on Parasnath (in Chota Nagpore) at 4000 feet alt.; *C. speciosa*, Kunth, a strongly-marked isolated (but very variable) species, is found in Malabar, Chota Nagpore, East Himalaya, Assam. Keeping in view the short distance from the Garo Hills or from Sikkim to Rajmahl, it is an important observation that so few plants have been able to struggle across 200 or 250 miles. It is true that the rising of the Himalaya is a thing of yesterday; still there have been considerable oscillations in level since, and Khasia was there long before; how few species have been carried across by birds, drift-wood, and other accidents! The Flora of Chota Nagpore is worth a special review; it is essentially that of Central India, but there are a very few species which have got across from Khasia; such are the strongly-marked *Fimbristylis Hookeri*, Boeck., less certainly the (Campanulaceous) *Cephalostigma Hookeri*, C. B. Clarke.

The *Carex* sect. *Indicæ* are pre-eminently subtropical: they are abundant in species and in individuals in India, but extend little beyond India—only a few species of the Sect. have been received from China, a few from Africa and Trop. America.

Considering the component portions of the *Vigneæ*, &c. under the same heads:—We have 9 species that belong to the European component (such as *C. divisa*, Hudson, *C. incurva*, Lightf., *C. vulgaris*, Fries); these extend from Temperate Europe (several from England) to the North-west Himalaya; here they occur at high levels, and very few reach east even to North Sikkim. There are 4 species (3 of which are Kobresias) which represent the Central Asian component, and just enter the higher Himalaya.

There are 7 species belonging to the Eastern component, only in East Himalaya or Khasia; no one of these extends down the Malay Peninsula, and (therefore?) no one is found in the Nilghiri-Ceylon area.

The 5 remaining Non-Endemic species have a much more extensive range; they are abundant plants, and all occur in the Nilghiri-Ceylon Region, viz.:—

(1) *C. nubigena*, D. Don—from Cabul to China.
(2) *C. longipes*, D. Don—from Nepal to China.
(3) *C. brunnea*, Thunb.—Mascarenia to Japan, Australia, Sandwich Isles.
(4) *C. phacota*, Spreng.—from South Africa to Japan.
(5) *C. rara*, Boott—Khasia to Japan, Borneo, Australia.

The Endemic *Vigneæ*, &c. (32), follow closely the example of the Endemic *Propriæ* and *Indicæ*—one, *C. Arnottiana*, Drejer, is confined to Ceylon; the remaining 31 are confined to the

Himalaya and Khasia, except that the Khasia *C. longicruris* reappears in the Nilghiri-Ceylon region. To say more about these, would be to repeat what has been said about the *Propriæ* and *Indicæ*.

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Summing up the geographical distribution of the Caricineæ, we see that there are 2 major and 2 minor Non-Endemic Components in the Indian Flora, to which parallel Endemic Components correspond. These are:—**(1)** the European, **(2)** the Eastern, **(3)** the Central Asian, **(4)** the *few* Hemisphæric.

**(1)** The European non-endemic species (27) enter India at the north-west angle and extend half of them over our West Himalayan tract, half of them to East Himalaya or Assam. With these are 55 endemic Himalayan plants.

**(2)** The Eastern species of Assam and the East Himalaya, a few extending down the Malay Peninsula. These may be reckoned 23 species, whereof 6 reappear in the Nilghiri-Ceylon Region. With these are 4 endemic Nilghiri-Ceylon species, and 22 Eastern endemic species, whereof 3 reappear in the Nilghiri-Ceylon region.

**(3)** The Central-Asian component of 12 non-endemic species which just enter the high Himalaya from the North, and with which may be arranged perhaps 8 endemic plants—Kobresias and high-level Carices—which are altogether Central Asian in character.

**(4)** The Hemisphæric component, of 5 to 7 species, which are scattered from Africa to Japan, Sandwich Islands, and New Zealand.

It will be noticed that, omitting very few species of which few examples have been collected, the areas of the Caricineæ in India do not fill up one-third the whole area of the Empire. This is not entirely a question of elevation-above-sea and coolness, for there are large areas of the Deccan at considerable elevation where no *Carex* has yet been found, while there are several species in Assam that have (as yet) only been found at low elevations. It is more a matter of moisture; but from Chittagong to Singapore *Carex* is not prominent, though the country is moist enough as well as jungly and hilly enough.

### *The Distribution of the Indian* Cyperaceæ *compared with that of the* Caricineæ.

Scleria.—In this genus, of the 29 species in India, 11 occur in only one of the regions discussed under Caricineæ, and therefore prove little. Two or three are rice-field weeds—hemisphæric or cosmopolitan in area. But there are no less than 11 species of our Eastern Region which extend also to our Nilghiri-Ceylon Region; several of these are South Malay, not extending north to Khasia, and therefore support the theory that the Nilghiri-Ceylon component of the Indian Flora was derived from the same source as the Eastern, but did not come to Ceylon from Khasia, *viâ* Chota Nagpore. Specially to be noted in this argument are *Scleria zeylanica*, which extends from Borneo to Pegu, but not farther north; *Scl. chinensis,* Kunth, which is found in Ceylon, Singapore, Malaya; *Scl. Neesii,* Kunth, found in Ceylon and Malaya.

The Suborder Mapanieæ, *en masse*, belong to the Eastern component of the Indian flora; they lie in the Malay Peninsula, one species, *Hypolytrum latifolium,* L. C. Rich., extending to Khasia and Sikkim, with an important parallel group in the Nilghiri-Ceylon Region. The closely-allied species occur either in the Malay Peninsula (a few in Pegu) or in Ceylon. The strongly-marked *Lepironia* occurs in Ceylon and in the extreme south of the Malay Peninsula (also in Mascarenia, Australia).

Remirea is confined to South India, but it is a sea-shore plant, and its distribution proves little beyond this.

Gahnia is specially an Australian genus, two species of which extend to the South Malay Peninsula.

Cladium is specially Australian. *Cladium Maingayi* and *C. glomeratum* reach the South Malay Peninsula. *C. undulatum*, Thwaites, is confined to Ceylon and Malaya. *C. riparium* var. *crassa* is only known from the sea-coast of Bengal and Ceylon; the abundant growth of this at 5000 feet elevation at Shillong may possibly yet be that of an introduced plant.

Rynchospora.—*R. glauca*, Vahl, and its var. *Griffithii* occur in our Eastern Region, also in Nilghiri-Ceylon. *R. gracillima,* C. B. Clarke, occurs in our Eastern Region, also in the Nilghiri-Ceylon Region (also in the Nicobars). The remaining species occur either in our Eastern Region or in the Nilghiri-Ceylon Region.

I refrain from analyzing in detail the Scirpeæ and Cypereæ; we should find in them many species common to our Eastern and Nilghiri-Ceylon Regions, and numerous groups with representative species in those two Regions; we should also find the European component, distinctly marked, coming into India at the north-west angle in the shape of *Eriophorum*, some *Scirpus*, &c. Still, owing to the large number of cosmopolitan species and weeds of cultivation in the Scirpeæ and Cypereæ, I do not think a laborious analysis would add much to the very strong illustrations given by the other suborders.

The existing Flora of British India is supposed to be made up of five principal components, in order of time as follows:—

**(1)** The Flora of the uncultivated parts of the Deccan, our sub-subareas **(3)** and **(5)** at 0–4000 feet elevation, is the oldest; it extends to the Gangetic Plain in the North, and many species have, in modern geologic times, got over this plain to the drier parts of the Western Himalaya. This Flora may be supposed to have had a common origin with the Mascarene and African, and I propose for it as a name the "Indo-African element."

**(2)** The Flora of the Eastern Peninsula from Singapore to Assam (the Bruhmapootra Valley) may be little less ancient than the Indo-African element, and in the Miocene (?) age or thereabout it got across directly from the Malay Peninsula to the Ceylon and South Malabar Mts. This I have called the "Eastern element."

**(3)** The "Central Asian element," which would first enter in Tertiary times, but which must have been on the extreme north margin of India ever since the Himalaya attained an elevation of 12,000 feet.

**(4)** The "European element," which arrived shortly after the Central Asian at the west end of the Himalaya, and doubtless travelled rapidly east, the continuity of the range offering no obstacles.

**(5)** The "Quaternary element," which occupies the cultivated lands and roads, and accompanies man.

It would be quite beyond the scope of the present paper to attempt to show that the geographic distribution of the other Natural Orders in India led to the same conclusions which I have drawn from the Cyperaceæ. It is so easy to pick out a few striking instances that make for one's own theory, and to overlook or underestimate others; it would be difficult to establish any conclusion without a complete tabulation and analysis of the whole material. The Cruciferæ are evidently part of our European element, and entered India at Kashmir; the Dipterocarpeæ are part of our Eastern element, and entered India from the South-east, and soon found a way across to the Nilghiri-Ceylon region. But it is not so easy to make summary statements about Leguminosæ, Compositæ, Gramina, Orchidaceæ. Probably most Indian botanists will agree that there is a vast mass of genera which extend throughout the Himalaya and Khasia, often reaching to the Malay Peninsula and islands, which are absent, or nearly so, from the Madras Peninsula; that, at some time since the present Orders and Genera of Phænogams were pretty well settled, there has existed a much easier route for plants from the Malay Peninsula to the Nilghiri-Ceylon area than now exists. As illustrations (not proofs) of these statements, I give five examples:—

(1) The genus *Quercus* extends from Kashmir to Malaya—numerous in species and individuals, but no Oak is indigenous in Ceylon, Malabaria, or Coromandelia. The Oak probably reached India with the Eastern element, and it appears not improbable that it travelled along the Himalaya westward.

(2) The Pines have a similar distribution in India to the Oaks, with the exception that one Conifer, *Podocarpus neriifolia*, D. Don, has reached the Nilghiri-Ceylon area from the Malay Peninsula. In this case the Pineæ proper may have entered India at Kashmir, whilst the genus *Podocarpus* may have come from the South-east.

(3) The Ericaceæ have a similar distribution to the Oaks, with the exception that TWO species (*Rhododendron arboreum*, Smith, and *Gaultheria fragrantissima*, D. Don) have reached Ceylon and the Nilghiri. It is possible that these two plants from Burma, or from some southern spot in the Malay Peninsula which they once occupied, reached Nilghiri-

Ceylon by the same route the Dipterocarps travelled; but I do not see that their present distribution favours the hypothesis of this route more than any other.

(4) *Primula* and *Androsace* are numerous in the West and High Alpine Himalaya, two species reaching Khasia; no species elsewhere in India. These two genera appear to belong to our European element altogether.

(5) *Lagenophora* is a genus of Composites, its headquarters Australia; *L. Billardieri*, Cass., is in Malaya, in Khasia, and in Ceylon—nowhere else in India.

(6) None of these genera or suborders, *Quercus*, *Rhododendron*, *Primula*, absent, or nearly so, in the Madras Peninsula, occurs in Tropical or South Africa.

[N.B.—The spelling of the localities is that in each case on the collector's ticket. This is at least as right as modern transliteration. I have not attempted to make the spelling uniform, as I cannot do this, even on my own ground, without risk of introducing error; thus I hesitate to alter Jopoo, in Muneypoor, to Jakpho, though I suspect they may be the same place.—C. B. C.]

# RULES FOR BORROWING BOOKS FROM THE LIBRARY.

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Papers read after the middle of January and before the end of April are published on **1st July.**

Papers read in May and June are published on **1st November.**

# NOTICE.

Vol. XXVI. is still in course of issue, and the Parts already published are as follows:—

Vol. XXVI., Nos. 173–177.

[Nos. 178–180 are reserved for the continuation of Messrs. Forbes and Hemsley's 'Index Floræ Sinensis.' The MS. is nearly ready to the end of Cyperaceæ, and the authors hope to complete the volume at an early date.]

Vol. XXVII., Nos. 181–188. (Complete.)

Vol. XXVIII., Nos. 189–196. (Complete.)

Vol. XXIX., Nos. 197–204. (Complete.)

Vol. XXX., Nos. 205–211. (Complete.)

Vol. XXXI., Nos. 212–219. (Complete.)

Vol. XXXII., Nos. 220–227. (Complete.)

Vol. XXXIII., Nos. 228–234. (Complete.)

Vol. XXXIV., No. 235. The present part.

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The first Meeting of the Session 1898–99 will be held on THURSDAY, NOVEMBER 3rd, when the Chair will be taken at 8 P.M. precisely.

April 1. Price 3s.

# THE JOURNAL
OF
# THE LINNEAN SOCIETY.

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NOTE.—The Charter and Bye-Laws of the Society, as amended to the 19th March, 1891, may be had on application.

# On the Biology of *Agaricus velutipes*, Curt. (*Collybia velutipes*, P. Karst.). By R. H. Biffen, formerly Frank Smart Student of Gonville and Caius College, Cambridge. (Communicated by Prof. H. Marshall Ward, D.Sc., F.R.S., F.L.S.)

[Read 1st December, 1898.]

(Plates **2-4**.)

In the early part of the year an abundant crop of the sporophores of *Agaricus* (*Collybia*) *velutipes* * grew on a pile of old chestnut and poplar wood in the Cambridge Botanic Gardens. It was also frequently met with on elm and willow trees in the neighbourhood. This early appearance of sporophores is unusual among the Agaricineæ, and *Collybia velutipes* is one of the few forms which persist through the winter uninjured by the frost. It may even be found pushing its way through the snow †. The large conspicuous clumps of tawny yellow sporophores grow from the base to some height up the tree-trunks. In the case of one elm, the greater part of which was dead, the sporophores were found growing at a height of forty feet above the base.

The conspicuousness of this common fungus has led, as one might expect, to numerous descriptions of it, even among the older writers. Thus Curtis ‡ describes and figures it, under the name of *Agaricus velutipes* or the velvet-stemmed *Agaricus*, in the 'Flora Londinensis,' noting that "the sheath or egg (volva) and the ring or ruffle (velum partiale) are wanting." "Its velvety and sooty stalk, most conspicuous in those which are advanced, serves as a distinguishing characteristic from other Agaricineæ."

Sowerby § again describes and figures it, and calls attention to the extraordinary length of the stipes in specimens growing in a shed, and to "the pollen or white dust which lay on the upper half of the stipes like white-wash, and gave the plant quite a new aspect."

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* *Agaricus velutipes* is the original name used by Curtis for the fungus described by Dillenius in Ray's 'Synopsis Stirpium Britannicarum,' ed. 3, p. 9, n. 51.

Other synonyms:—*A. mutabilis*, Huds. Flor. Angl. p. 215; *A. nigripes*, Bull. Champign. tab. 344; *A. Aesculi*, Schum. Enumerat. ii. p. 306; *A. austriacus*, Trattin. Fung. Austr. taf. 7. I have used Karsten's name throughout this paper.

† Winter, Rab. Krypt.-Flor., Bd. i. p. 779.

‡ Curtis, Flor. Lond. vol. ii. pl. 213, 1798.

§ Sowerby, English Fungi, vol. iii. pl. 263.

It is exquisitely figured in Hussey's * 'Illustrations of British Mycology,' and complete descriptions are to be found in the works of Saccardo, Cooke †, and Massee ‡.

*Collybia velutipes* belongs to the *Leucosporeæ*. The pileus is from 1 to 3 inches in diameter; at first it is convex, with a distinctly recurved margin, then it becomes plane and even slightly umbonate. In young specimens the surface is smooth and dry, but as they grow older it becomes slimy, especially in wet weather. The flesh is thin, especially at the margins, where it is semitransparent. The gills are ochraceous, subdistant, broad, and slightly adnate. The stem is slender, and varies a great deal in length; usually it is about 2 inches long, but occasionally as much as 9 inches. It is hollow and stuffed, and spreads downwards into a rooting base of a deep brown colour, with a velvety surface. The colour is a rich tawny ochre, becoming grey on the upper surface when slimy. On drying, the cartilaginous sporophores become more brittle. They may be found throughout the greater part of the year, but most abundantly in the winter and early spring.

Apparently no very complete study of the anatomy of *Collybia velutipes* has yet been made, although Costantin and Matruchot § described a method by which pure cultures of it could readily be obtained, and exhibited their results at the Exposition de Champignons de la Société mycologique in 1884. Van Tieghem ‖ has described the formation of oidia and recognized their purely vegetative function, and also the interesting fact that fragments of sporophores are capable of giving rise to fresh sporophores.

Brefeld ¶ examined the adult anatomy of *Collybia velutipes* among other species of *Collybia*, and obtained oidia from the mycelium formed by germinating basidiospores. The growth of his cultures, however, did not extend beyond the oidial stage. Further, Hoffmann * has traced the development of the sporophore. Reference will be made to these papers in more detail later.

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* Hussey, Illustr. Brit. Myc. pl. 56.

† Cooke, Handbook Brit. Fungi, vol. i. p. 55; Illustr. pl. 184 A.

‡ Massee, Brit. Fung. Flora, vol. iii. p. 127.

§ Costantin et Matruchot, Comptes Rendus, vol. 119. p. 752.

‖ Van Tieghem, Bull. de la Soc. bot. de France, t. xxiii. p. 101.

¶ Brefeld, Unters. aus d. Gesammtgeb. d. Mykol., H. viii. p. 56.

The method of culture adopted was as follows:—Ripe sporophores of the fungus were placed with the gills downward in clean, covered watch-glasses, and some of the spores deposited transferred with a sterile needle to tubes of gelatine, containing from one to two per cent. of cane-sugar, from which drop-cultures and plates were prepared †.

The early stages of germination were followed in hanging-drops under the microscope. In 24 hours at a temperature of 17° C. the first hyphæ appear; they branch and grow rapidly for seven days, forming a tangled septate mycelium, which then becomes very vacuolated, and on the eighth day the ends of its hyphæ begin to septate off to form oidia. In another day practically the whole mycelium has broken up into oidia-chains (Pl. **2.** fig. 1). The oidia are rod-shaped, with slightly rounded ends. They vary considerably in length, $3–8{\cdot}5\ \mu$ being the extreme measurements obtained, while their breadth of $2\mu$ is fairly constant. Each contains a distinct nucleus.

No further changes were found to occur in these hanging-drops, although kept under observation until they became dried up. Meanwhile, a similar development occurred in the plate cultures, and oidia from them were transferred to blocks of sterilized horse-chestnut wood, placed in large, plugged test-tubes, and kept moist with cotton-wool saturated with water. The sterilization was effected by heating the tubes containing the blocks, and the cotton-wool plugs in a steam-sterilizer for an hour, half an hour, and quarter of an hour, on three successive days. Three days after infection a slight mycelium is visible to the naked eye, which spreads gradually, and in a few weeks forms a thin, mealy layer over the whole surface of the block. A month after infection (Jan. 31st., March 1st) the sporophores are obtained. The mycelium at the point of formation turns an umber-brown colour, and in the centre of the patch a small rounded body 0·5–1 mm. in diameter appears, from which sporophores rapidly develop. These small, rounded bodies represent the sclerotia found in other species of *Collybia*, e. g. *C. tuberosa*, P. Karst. A distinct differentiation into pileus and stipes is noticeable when the sporophore is a few days old. As an example to show the time of development, I quote one of the first formed sporophores: the sclerotium was recognizable 32 days after infection; in 34 days two small rounded projections could be distinguished with the help of a simple lens, which two days later (in 36 days) had grown to a height of 3 mm. and showed a distinct stipes surmounted by an overlapping pileus. A week later the sporophore was fully grown and commenced to shed its spores (Pl. 2. fig. 2).

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* Hoffmann, in de Bary's Comp. Morph. & Biol. of Fungi, etc. p. 297.

† See Marshall Ward, Phil. Trans. 1897, vol. 189. P. p. 123.

The mature sporophores are about 2 inches high, and the pileus is about half an inch in diameter. They are readily recognizable from the descriptions quoted, though more slender in habit than the naturally grown specimens and with a general likeness to the closely allied genus *Marasmius*. The slimy appearance of the upper surface of the pileus, so characteristic of the species, becomes very marked as the sporophore reaches maturity. Then its colour changes slightly, becoming a little duller, watery drops are exuded, and it becomes soft and slimy.

The basidiospores are produced in abundance, and when shed frequently form well-marked patterns of the gills on the sides of tubes. If transferred to sugar gelatine they readily germinate. The size of the basidiospores is very variously stated; thus Winter gives them as 8–10 × 4–5 $\mu$, Cooke ·00027 inch, Massee 7 × 3–3·5 $\mu$, Stevenson 8–10 × 4–5 $\mu$. These variations seem too large to be accounted for as mere personal equation errors, and tempt one to suppose that the size is not so good a criterion as it is often assumed to be, owing to differences in growth under varying circumstances. However, a series of closely agreeing observations taken in water from spores of a naturally grown specimen, about 2 inches in diameter, gave 7·0–7·7 × 4·4 $\mu$; while a similar set of observations from a pure culture specimen, less than half an inch in diameter, gave 7·2–7·7 × 4·4 $\mu$.

The formation of spores ceases, and the sporophores wither and dry, when about fourteen days old. Then, so far as appearances go, they are dead; but if kept for some time longer (four months in this case) they show unmistakable signs of life, for fresh sporophores are found to be springing either from the pileus or the stipes. These secondary sporophores may even produce others in their turn (fig. 3). This phenomenon of purely vegetative reproduction may probably be brought into correlation with the normal course of events in other species of *Collybia*. As is well known, several species are in the habit of forming sclerotia*, e.g., *C. tuberosa*, P. Karst., *C. cirrhata*, P. Karst., *C. racemosa*, P. Karst.; and at least one species, *C. platyphylla*, P. Karst.†, develops analogous structures in the form of mycelial strands which, if hard and dark-coloured, would be termed rhizomorphs, for like the latter both sclerotia and strands develop new sporophores. In the sporophores of *C. velutipes*, however, we have a sort of delayed sclerotium, capable of acting as such, however, under certain circumstances; and thus the greatly reduced condition of its sclerotia becomes more intelligible.

The growth of the lower surface continues for a longer time than that of the upper, so that its convex surface is gradually flattened out, and in some cases where growth is exceptionally continued it even becomes concave, and so the gills are far more exposed than usual.

A superficial observation of a growing cluster of sporophores at once convinces one that they are responsive to the stimulus of gravity, for they contrive to grow so that their gills always point directly downwards. This geotropism is easily demonstrated by placing a tube containing a growing specimen in a position so that the plane of the pileus is at right angles to the ground. In a couple of hours the stipes becomes twisted so that the pileus is brought into a horizontal position. The process may be repeated several times with the same specimen. It often happens that sporophores begin to develop on the underside of the block. In these cases they invariably wither before complete development occurs, unless they are able to curve round it and so attain a position where it is possible for the gills to grow downwards.

The blocks infected in the beginning of February produced sporophores continually from the beginning of March to the middle of June. By this time the majority of them had withered however, and were producing secondary sporophores. A further crop was formed during the first week in August.

Cultures grown in the dark or shaded with red blotting-paper form an external mycelium indistinguishable in kind and quantity from those grown in the light, but the growth of the pileus seems to be inhibited to a certain extent; at any rate its appearance is delayed, and eventually slender stipes, an inch or an inch and a half high, are produced bearing only a minute pileus.

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* *Cf.* Van Tieghem, Bull. de la Soc. bot. de France, t. xxiii. 1896, p. 101.

† Fayod, Ann. des Sci. Nat. 7 sér. t. ix., 1889, pp. 206, 208, 210; Brefeld, Unters. aus d. Gesammtgeb. d. Mykol., H. viii. p. 56.

‡ Fayod, loc. cit. p. 201. Bommer, Mém. Cour. de l'Acad. Roy. Sci. Belg. t. liv. p. 14.

As it seemed possible that the cultures in plugged test-tubes might suffer from being insufficiently aerated, others were put up in U-tubes and flasks through which a stream of moist, filtered air was drawn by means of an aspirator. In these cultures the external mycelium was a little thicker, but the sporophores, which were later in forming, were no larger than those in the plugged tubes. In order to see whether the steam-sterilizing caused any washing out or destruction of nutritive substances in the wood, cultures were also made on blocks dry-sterilized by being heated as before, but without wetting the cotton-wool plugs at the bottom of the tubes until they were ready for infection. When compared with the wet-sterilized cultures, infected at the same time, however, no differences could be detected. In spite of this it is evident that some essential nutrient materials are dissolved out, for sporophores develop in abundance on the wet plugs of the wet-sterilized tubes, and none develop on the plugs of the dry-sterilized ones. The experiment only shows, then, that the amount dissolved is slight, and not sufficient to check the growth of the fungus.

Further, cultures were made on wood extracted with a boiling 5 per cent. solution of caustic potash, to remove xylose-yielding bodies, or with a 5 per cent. solution of hydrochloric acid to remove hemicelluloses. These solutions were then thoroughly washed out with distilled water, which was changed at frequent intervals for a week. In both sets of tubes the growth of the mycelium was extremely slow, and so far no sporophores have been produced (infected for 12 weeks).

Microscopic examination of the external mycelium shows that it is septate, with numerous clamp connections. Its mealy appearance is due to the large number of oidia-chains formed.

Longitudinal sections of the mature sporophore show a cortex bearing several forms of hairs, a medulla composed of loosely woven hyphæ, and a hollow stipes. If the sections are stained in eosin, or better in fuchsin-methyl green, a system of hyphæ, having a general resemblance to laticiferous cells, is differentiated by staining more deeply than the surrounding tissue. Its abundant granular contents and high refractive power also serve to make it more visible (Pl. 2. fig. 4).

In transverse sections of the stipes the hyphæ of this system appear as a deeply stained ring near its outer margin. These hyphæ push their way among the parallel hyphæ of the stipes, occasionally giving off blindly ending branches, which run either in the original direction or in the opposite one. From the stipes they run into the pileus, where they spread out over its lower surface and send down branches into the trama of the gills to form a layer immediately below the subhymenium. Here they either end in slight dilatations, or pass into the hymenium and end between the barren cells (Pl. 2. fig. 5). Very few branches are present in the upper portions of the pileus.

The system is evidently identical with the "conducting system" described by Istvanffi * in the closely allied genus *Mycæna* among others.

The structure of the cortex is unusually complex. The hyphæ, which are considerably smaller than those of the medulla, and arranged parallel to the surface of the pileus instead of being woven together in all directions, turn outwards and give rise to three distinct forms of hairs (Pl. 2. fig. 6). The most conspicuous are large, simple, and spindle-shaped, with granular contents coloured a yellowish-brown (*a* in fig. 6). Among these are clusters of three or four smaller hairs, which arise as branches from the apex of a hypha; they are often constricted at intervals so as to have a beaded appearance (*b*). Standing out above these two forms are long, fine, much-branched hairs, which often entangle basidiospores among them, and so give rise to the "white-washed" appearance of the sporophores described by Sowerby (*c*). It seemed probable that the sliminess of the upper surface might be due to the formation of mucilage by these hairs, either as a secretion, or by the mucilaginous degeneration of their walls. Sections were accordingly stained with methylene-blue and other mucilage stains, but no indications of its presence were obtained, nor were the walls found to be swollen. It is possible, then, that the sliminess is due to the quantity of water held by capillarity among these slender hairs; but whether any of the forms are specialized for the purpose of transpiring water could not be determined.

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* Istvanffi, Bot. Centr. vol. xxix. 1887, p. 373; Pringsh. Jahrb. 1896, p. 391.

Incidentally, though, it may be noticed that watery drops are exuded from any part of the sporophore and that they form most plentifully at its base. Their presence there is not due to their running down from the higher parts of the stipes, for even casual observation of their formation shows their gradual growth there, and moreover the drops usually remain at the points where they are secreted, sometimes even for a week after the sporophore has withered.

The gills show the usual *Agaricus* type of structure *—a loose medullary portion, the trama, subhymenium, and hymenium, with basidia bearing four sterigmata and basidiospores. Brefeld † states that no cystidia are present in this species, but I find that they are plentiful, especially at the apex of the gills. They are simple and spindle-shaped, rarely showing signs of branching at the apex, and are full of protoplasmic contents (Pl. **2.** fig. 7). In several cases these cystidia were found to be terminations of the "conducting system."

Owing to the number of sporophores which appear at intervals on the blocks, this method of culture is especially favourable for a study of their development. For this purpose a block was chosen showing all stages from the first umber-coloured spots to the mature sporophores, and fixed in Flemming's solution. After a thorough washing in water it was taken through the usual dilutions of alcohol to absolute alcohol. Thin strips of wood bearing different stages of the sporophores were then sliced off, imbedded in paraffin-wax, cut into serial sections with a microtome, and stained with dilute Delafield's hæmatoxylin or Bismarck brown. In the sections of the earliest stages the hyphæ were found to emerge in thick strands, especially from the medullary rays, to form small sclerotia (Pl. **2.** fig. 9). These sclerotia are composed of loosely woven hyphæ throughout, and show no differentiation into a cortical and a central portion. Each gives rise to one or, less frequently, two sporophores. They are thus a simpler form of the large sclerotia with strongly thickened cortical layers, capable of producing several sporophores, which are met with in other species of *Collybia*, e. g., in *C. tuberosa*, P. Karst., and *C. cirrhata*, P. Karst. The sporophores are first visible as minute projections from the sclerotia. Even in the earliest stages they may be distinguished from the sclerotia in sections, by the fact that their hyphæ run for the most part parallel to one another, while in the sclerotia they are woven together in all directions. The upper surface of the young sporophore is moreover covered with large simple hairs (Pl. 2. fig. 8).

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* See also Heese, Bot. Centr., Bd. xvii. 1884, p. 69.

† Brefeld, Unters. aus d. Gesammtgeb. d. Mykol., H. viii. p. 56.

When from 2 to 3 mm. high, the hyphæ in the upper part spread out to form the pileus, and the characteristic "button" shape of the Agaricineæ is thus produced. At the same time a certain amount of differentiation takes place in the tissues. In the stipes the central hyphæ are apparently pulled apart and form a loose central tissue, while the outer layers are close and compact and covered with large pigment-containing hairs. The pileus also is differentiated into a loose medullary portion and a closely felted cortical layer, again covered with large, simple, pigment-containing hairs. The tissue which ultimately gives rise to the hymenial layers may also be distinguished as slender parallel hyphæ running in a downward direction. Occasionally, in specimens of this size or slightly larger, the loose medullary portion appears to be broken down at the base of the pileus to form a "tunnel," but this is not really the case. The subhymenium is formed directly from the hyphæ on the free lower surface and is never enclosed in a cavity* (Pl. 2. fig. 10). The only approach to a *velum partiale* is afforded by the large hairs of the recurved margin pointing towards the stipes, though not confluent with it. It is interesting to compare this with the usual type of formation of the *velum partiale*, of which *Agaricus melleus*, Vahl†, serves as a good example. Here the rudimentary tissue of the hymenial layers is at first freely exposed, but later hyphæ from the margin of the pileus and from the stipes grow across the intervening space and form a *velum partiale*, which for a time keeps pace with the growth of the sporophore by intercalary growth but is finally ruptured, part of it forming the ring on the stipes. In this case the sporophore is primarily gymnocarpic and later becomes angiocarpic; but in *Collybia velutipes* it is truly gymnocarpic in the sense of the word as used by Brefeld, for its hymenium is never enclosed either by a *velum partiale* or a *volva*.

The development of the gills does not offer any essentially new points, but it may be noted that the cystidia can be distinguished from the cells of the hymenial layer at an early period, for instance in sporophores 3 mm. high.

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* *Cf.* Hoffmann, in de Bary's Comp. Morph. of Fungi, etc., p. 297.

† De Bary, ibid. p. 291.

The growth of the sporophore, until it reaches its full size, is now very rapid, but no new points of interest were brought out in investigating it. It should be remembered that the measurements given above are from cultures which are smaller than those grown under more natural conditions.

In order to investigate the action of the fungus on the wood, a series of infected blocks were prepared at intervals of a week or fortnight. The first few were fixed with Flemming's solution, well washed in water, and taken through 50, 70, and 90 per cent. to absolute alcohol. This method was found to dissolve the lignin slightly from the elements at the edges of the blocks, and was therefore abandoned. Instead, the blocks were boiled for a short time, to fix the hyphæ *in situ*, and then taken through the same series of dilutions of alcohols as before.

On rubbing off the outer mycelium the wood was found to be marked with dark brown patches and lines, or, if the culture was an old one, it was a uniform brown all over, but the affected parts were still hard and showed no signs of disintegration. To trace the course of the mycelium, dilute Delafield's hæmatoxylin and picric-aniline-blue were used as stains. Radial sections of a block infected a week previously show that the oidia on the surface of the wood have germinated, and that the hyphæ they give rise to have penetrated several layers of tracheids in depth into the wood. Possibly on account of chemotaxis they enter chiefly through the pitted walls of the medullary rays. If a transverse surface is infected they penetrate for the most part by the wide vessels. All stages in the germination of the oidia and the penetration of their hyphæ occur in cultures of this age (Pl. **3**. fig. 11).

As soon as the hyphæ have formed a small mycelium in the vessels and tracheids, it is again broken up into oidia (Pl. **3**. fig. 12), which quickly germinate, for very few are to be found in cultures a week older, and thus the wood is permeated by a large mycelium in a short time. In fact in cultures three to four weeks old it is difficult to find any of the wood elements free from hyphæ which have penetrated through the pits of the walls, the medullary rays again serving as the easiest path into the wood-elements (Pl. **3**. fig. 13).

Strands of shortly septate hyphæ then begin to form (Pl. **4**. fig. 14), which ultimately push their way through the wood to the surface, carrying out with them fragments of disintegrated tracheids and vessels *. These rhizomorphs are far simpler in structure than those of *Agaricus melleus*, for they consist merely of bundles of shortly septate hyphæ, unenclosed by any specialized cortical layer and without a definite growing-point. In much attacked parts of the wood the hyphæ are often of a rich brown colour, resembling that of the sporophore; but on carefully following them, the colouring is found to be restricted to small areas. The colour of the sporophore is not therefore due to this colouring-matter being directly transported to it. In the medullary rays the hyphæ often grow to a great size. A similar rank development of hyphæ is described as occurring in *Polyporus borealis*, Fr., among other wood-destroying fungi †.

The first noticeable action of the mycelium is to destroy the starch contents of the medullary rays, and it is not until the infections are three or four weeks old that the characteristic action becomes evident. The thickening-layers of the tracheids and fibres are then seen in transverse sections to be pitted in many places, either as far as the first thickening-layer, or right through to the middle lamella ‡ (Pl. **4**. fig. 15). In longitudinal sections these pits are found to be grooves corroded out by the action of the hyphæ, which thus leave a map of their path (Pl. **4**. fig. 16). It frequently happens that these grooves lead directly to small irregular holes in the walls of the elements, showing where the hyphæ have turned to pass through a pit which has subsequently been enlarged. The action of the hyphæ is thus a very local one, quite unlike the action of the hyphæ of the *Botrytis* causing the lily disease* for instance, which by secreting an enzyme causes the cellulose-walls in its neighbourhood to swell and dissolve. The solvent action in this case, apparently, is exerted directly by the hyphæ in intimate contact with the cell-walls. In badly attacked wood the thickening-layers almost entirely disappear, leaving only a little granular débris.

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* *Cf.* Eichelbaum, Bot. Centr. 1886, xxvi. p. 205.

† Hartig, Zersetzungerscheinungen des Holzes, p. 56.

‡ The view taken here with regard to the constitution of the walls of the wood elements is, that the middle lamella is primarily composed of cellulose or pectates, which during the process of lignification is impregnated with a substance or with substances known collectively as lignin [1]. The thickening-layers consist of cellulose, again impregnated, but to a lesser extent, with lignin. The staining-reactions for the presence of vanillin, coniferin, and pectates failed to give any satisfactory results when employed during this research.

This view is consistent with the results given by the employment of Wisselingh's cellulose test [2], and with Hoffmeister's method of analysis [3]. In the former the glycerine exerts a gradual solvent action on the lignin, dissolving it completely from the thickening-layers, before dissolving it altogether from the middle lamella.

[1] *Cf.* Tollen's Handbuch der Kohlenhydrate, vol. ii. p. 270.

[2] Wisselingh, Pringsh. Jahrb. 1898, p. 619. See also p. 158 of present paper.

[3] Hoffmeister, Landwirthschaftlichen Versuchs-Stat. 1898, p. 347.

Staining with phloroglucin and hydrochloric acid shows that the lignin of the middle lamella, and the corroded thickening-layers still persist, even in the remains carried out by the strands of hyphæ. The powdery débris of the thickening-layers also gives the deep pink coloration due to lignin. Chlor-zinc-iodine colours the sections a bright golden yellow, except in cases where the blocks have been treated with Flemming's solution, when a very slight cellulose reaction is sometimes given by the elements on the outside of the blocks. These two tests make it evident that the lignin of the wood is not destroyed. Had this been the case, instead of obtaining a yellow coloration throughout with chlor-zinc-iodine, a deep purple would have been produced, owing to the cellulose reaction being no longer masked by the presence of lignin. We can, however, extract the lignin by Wisselingh's method †, and thus show it is really cellulose which is attacked. For this purpose sections of the infected wood are heated to 300° C. with glycerine in sealed tubes for an hour, and then mounted in chlor-zinc-iodine. The lignin dissolves out, and the thickening-layers, showing the characteristic pitting, give the usual cellulose reaction. This method has the great advantage over the acid-extraction method, that it does not cause the walls to swell and obliterate their markings; and further, by regulating the time of heating, the lignin may be dissolved out from the thickening-layers and yet leave the middle lamella intact, so that the sections do not fall to pieces.

In the paper already referred to Wisselingh has succeeded in proving that the walls of fungi do not consist of a special form of cellulose known as fungus-cellulose, as it was believed until recently, but of chitin similar to that so frequently met with in the animal kingdom. On repeating his experiments with sections of infected wood, striking results are obtained. The sections are heated to 160° C. with concentrated caustic potash in sealed tubes, then washed in 90 per cent. alcohol, and placed in a dilute solution of iodine in potassium iodide until deeply stained, when they are transferred to diluted sulphuric acid. The cellulose-walls stain a deep blue-green colour, and the chitin walls of the hyphæ a brilliant pink. On washing rapidly in water the dark colouring of the cell-walls may be partially removed and their swelling prevented. Sharply differentiated preparations are obtained by this method, which may be utilized in tracing the course of the hyphæ (Pl. **4**. fig. 17).

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* Marshall Ward, Ann. of Bot. vol. ii. 1898, p. 339.

† Wisselingh, Pringsh. Jahrb. 1898, p. 619.

In the breaking down of the cellulose layers, bundles of acicular crystals of calcium oxalate are formed. They stain deeply with hæmatoxylin, probably owing to the precipitation of proteid matter upon them by the action of alcohol. When treated with sulphuric acid, however, a granular deposit of calcium sulphate is left in their place, thus proving that they really do consist of the oxalate.

On extracting the wood with caustic potash, and so removing xylose-yielding substances, a peculiar change is brought about in the action of the fungus. Transverse sections of the infected wood placed in chlor-zinc-iodine solution now give a cellulose reaction; the thickening-layers stain a deep purple colour and are swollen so as almost to obliterate the lumen, and in places they are wrinkled away from the middle lamella. These appearances are precisely the same as those given by wood infected with lignin-destroying fungi when so treated*. Similarly extracted, uninfected wood gives no such reaction. If however the wood, from which xyloses have been removed, is treated with a 1 per cent. solution of cane-sugar before infection, the action of the hyphæ is similar to that already described as normal, and the lignin is left unattacked.

It would seem, then, that soluble carbohydrates are of great importance in the proper nutriment of the fungus, but in their absence it is capable of varying its usual course of action and using lignin as a substitute. If we may regard this latter substance as a glucoside, as is often done, one might assume that in its decomposition glucose is produced and used by the fungus as a food-material.

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* Marshall Ward, Phil. Trans. vol. 189. B. (1897), p. 123.

The wood extracted with dilute hydrochloric acid is attacked, so far as one can determine, in the same manner as unextracted wood; but both here and in the former case sporophores have not been formed though the wood was infected for twelve weeks (May 23rd–Aug. 15th).

The growth of the sporophores on the sodden cotton-wool plugs is also to be explained by the presence of small quantities of soluble carbohydrates extracted from the wood during the wet-sterilizing process, for it was found impossible to grow them on moist cotton-wool only.

Attempts were made to extract the enzyme which, it is assumed, dissolves the cellulose by splitting it into soluble carbohydrates. Large flask-cultures were grown for this purpose on shavings, and extracted by grinding with sand and water, glycerine, sodium carbonate, or dilute hydrochloric acid. To these solutions a small quantity of potassium cyanide solution or chloroform-water was added, to check the growth of the bacteria which entered during the grinding. The filtered extracts were then tested with thin sections of wood and young stems, and with cotton-wool, but no difference could be detected between them and the boiled controls. However, the failure to isolate the enzyme cannot be taken as a proof of its absence, knowing, as one does, the difficulty of obtaining these bodies.

Testing water extracts of infected wood for sugars with Fehling's solution, or with phenyl hydrazine and acetic acid, and sections with α-naphthol and sulphuric acid, also failed to give results, so that if sugars are formed on the breaking down of the cellulose-walls, they are quickly changed by the action of the hyphæ *.

Another source of carbohydrate food-material is afforded by the glucosides so widely present in wood. Bourquelot † has shown that *Collybia velutipes* contains an emulsin-like enzyme, which on extraction was found to decompose æsculin and amygdalin with the formation of glucose.

A further enzyme, an oxidase, is also stated to be present in the sporophores of this fungus, but until it has been isolated and its action macrochemically tested, it is useless to speculate as to its functions.

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* Bourquelot, Bull. de la Soc. myc. de France, t. viii. p. 13.

† Ibid. t. x. p. 49.

Unlike most of the large wood-destroying fungi, then, *Collybia velutipes* chiefly attacks the cellulose portions of the wood-elements, leaving a lignin skeleton. Thus the infected wood does not appear to have undergone any profound changes until examined microscopically, the presence of the middle lamella not allowing the remains of the elements to become detached and so cause the wood to crumble away. In nature, however, the changes in the wood are far more complicated, owing to the action of the bacteria invariably met with in infected wood. It is quite within the bounds of possibility that the products they give rise to are utilized by the fungus itself, and so a kind of symbiosis (metabiosis) established.

My work throughout has been made considerably easier by the many suggestions of Prof. Marshall Ward, who originally proposed it, and I take this opportunity of expressing my thanks to him.

Botanical Laboratory, Cambridge,
Aug. 1898.

## EXPLANATION OF THE PLATES.

### PLATE 2.

Fig. 1. (*a*) Formation of oidia on the eighth day after infection in a hanging-drop culture.
(*b*) Oidia-chains a day older.

2. Mature sporophore of *Collybia velutipes*, grown on a sterilized block of *Æsculus*-wood. The age of the culture is 35 days. Photographed, natural size, from the original. *
3. A series of diagrammatic sketches of sporophores produced from the primary sporophore, which in these cases has functioned as a sclerotium.
4. A longitudinal section of the stipes of a mature sporophore showing the "conducting system." The hyphæ composing it are beginning to form branches.
5. Terminations of the "conducting system" in the subhymenium, between the barren cells of the hymenium, and in cystidia.
6. A longitudinal section from the upper portion of a pileus, to show the layer of small external hyphæ, large spindle-shaped hairs with yellowish-brown contents (*a*), the smaller hairs arising as branche from the apex of a hypha (*b*), and the fine much-branched, water-holding hairs (*c*).

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* Kindly photographed by Mr. W. G. P. Ellis.

Fig. 7. Section of a lamella with cystidia.

8. Early stage in the development of a sporophore from the rudimentary sclerotium. The large, pigment-containing hairs develop early and often serve to distinguish the sporophore from the sclerotium.

9. A longitudinal section of a sporophore about 2 mm. high, in which a cortical layer has been differentiated. The subhymenium is not differentiated yet.

10. An early stage in the development of the subhymenium, also showing the large hairs of the recurved margin pointing towards the stipes, but not joined to it. The sporophore was about 5 mm. high. From a microtome section stained in Delafield's hæmatoxylin.

### PLATE 3

Fig. 11. Germinating oidia, penetrating through the pitted wall of a tracheid; the wood infected a week previously.

12. Mycelium within the wood elements breaking up into oidia-chains; from the same preparation as fig. 11.

13. Radial section of a block of *Æsculus*-wood, infected four weeks previously. The irregular holes in the walls show where the hyphæ have pierced the walls and then further corroded them. The rosettes of crystals are formed of bundles of calcium oxalate raphides.

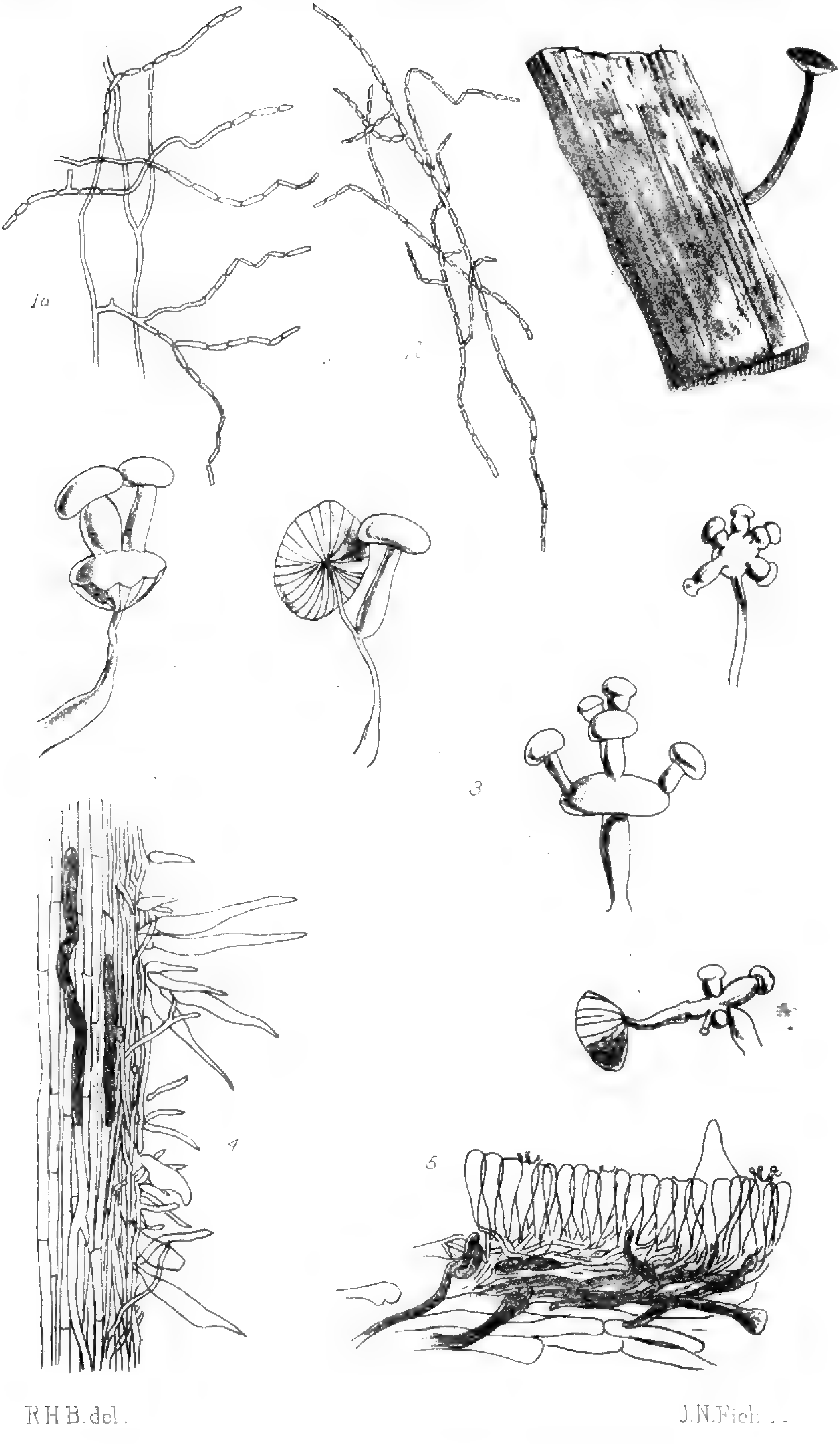
### PLATE 4.

Fig. 14. Hyphæ within the wood elements become shortly septate to form a rudimentary rhizomorph strand.

15. Transverse section of *Æsculus*-wood to show various degrees in the destruction of the thickening-layers, from slightly corroded portions, appearing as pits, to almost complete solution.

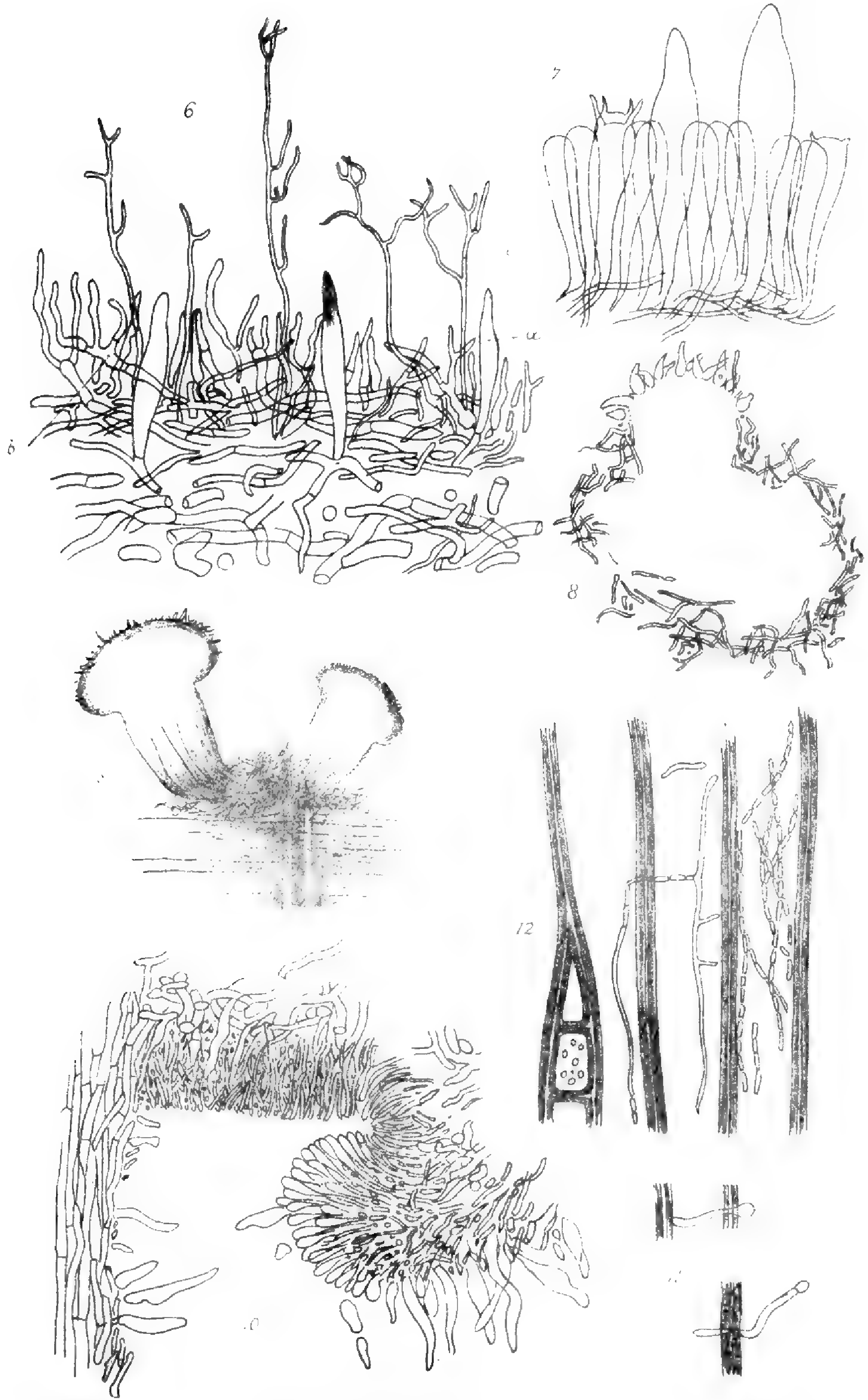
16. Longitudinal radial section of *Æsculus*-wood with the walls of the tracheids and medullary rays grooved and pierced by the action of the hyphæ; from a preparation stained in Bismarck brown.

17. Wood treated as described with caustic potash and stained with iodine solution and sulphuric acid. The lignified middle lamella is yellow, the corroded thickening-layers, blue, and the chitin-walls of the hyphæ, pink.



R.H.B. del. J.N.Fitch lith.

COLLYBIA VELUTIPES.



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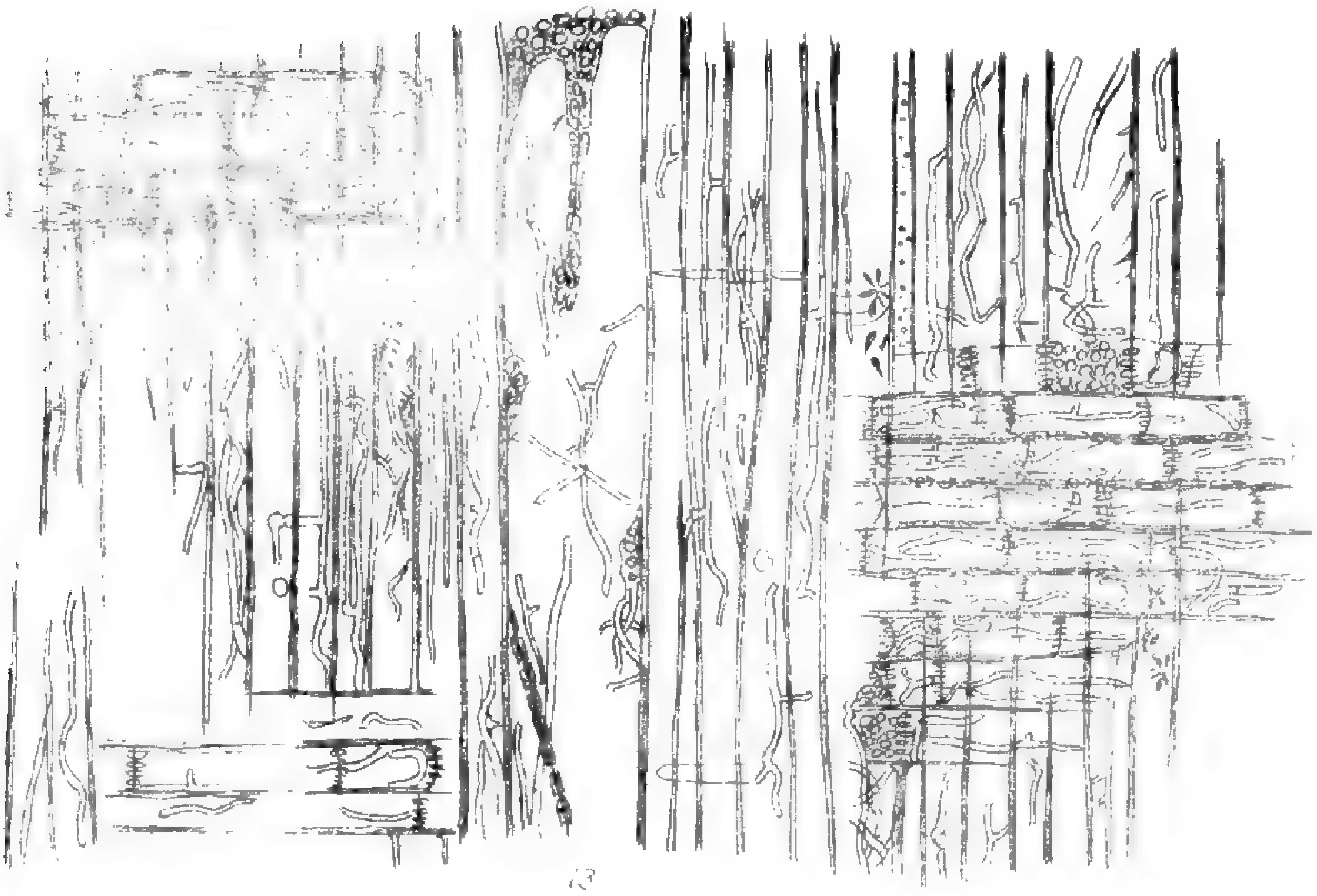
COLLYBIA VELUTIPES

J.N. Fitch lith.



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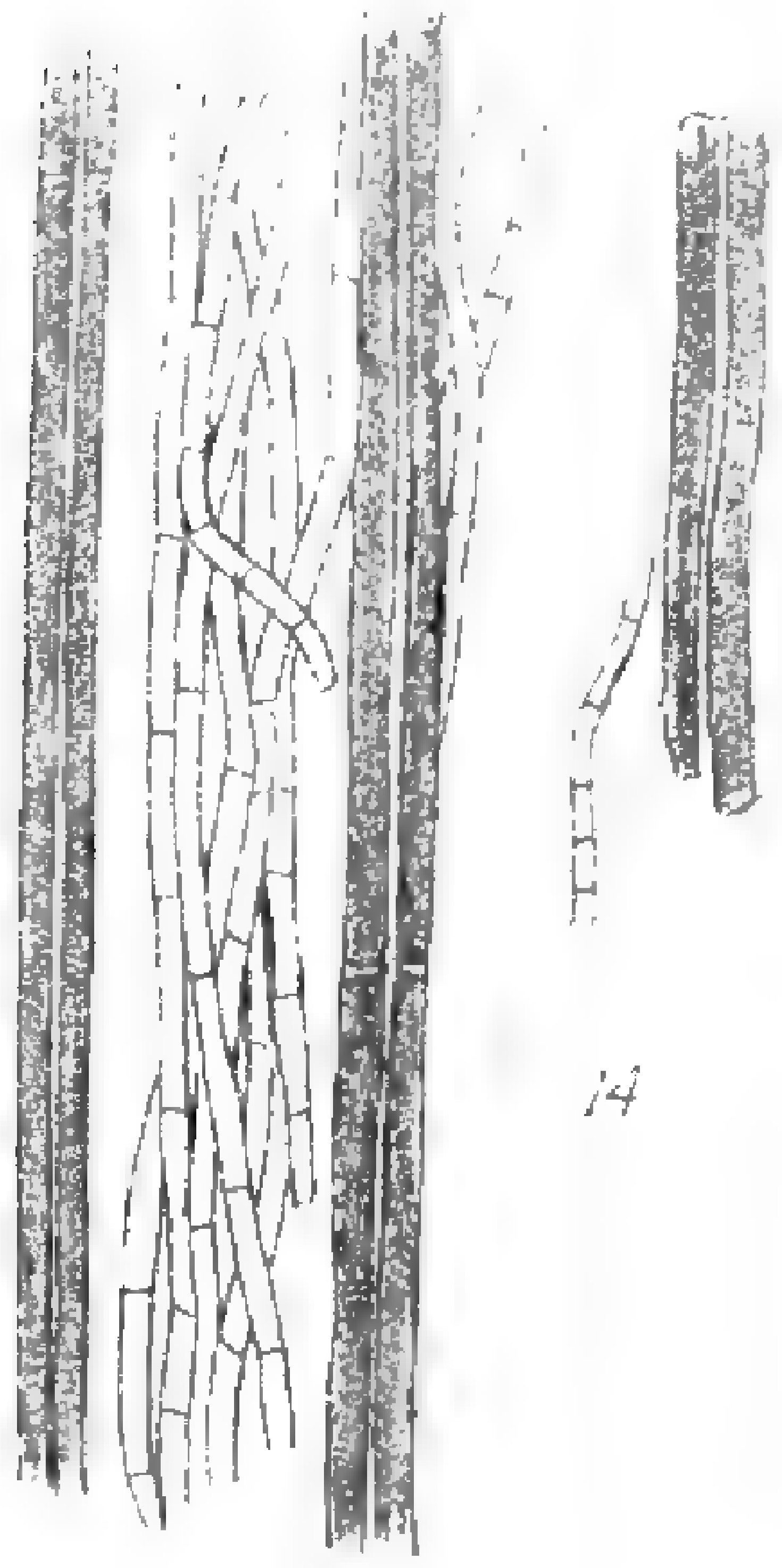

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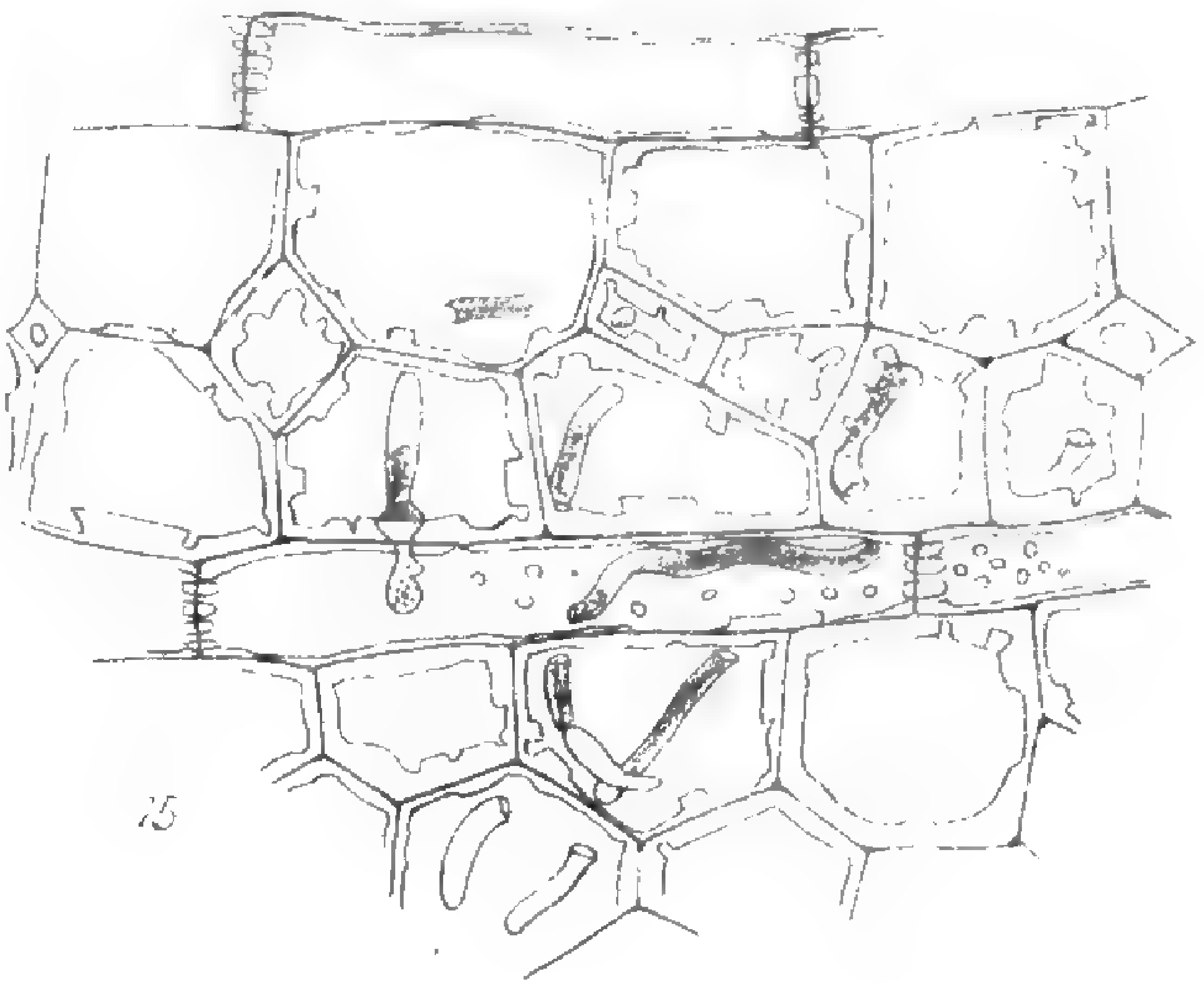

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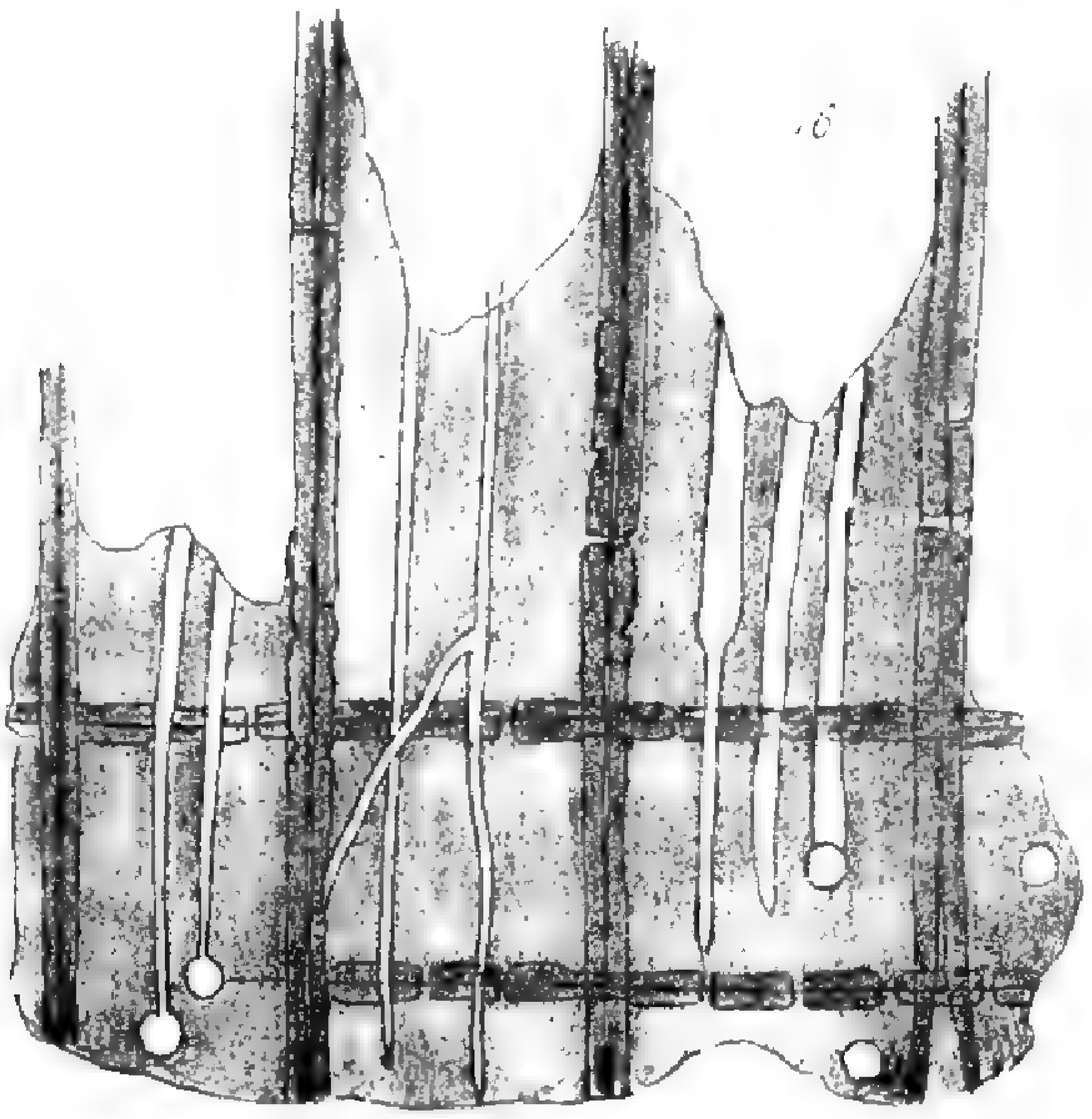

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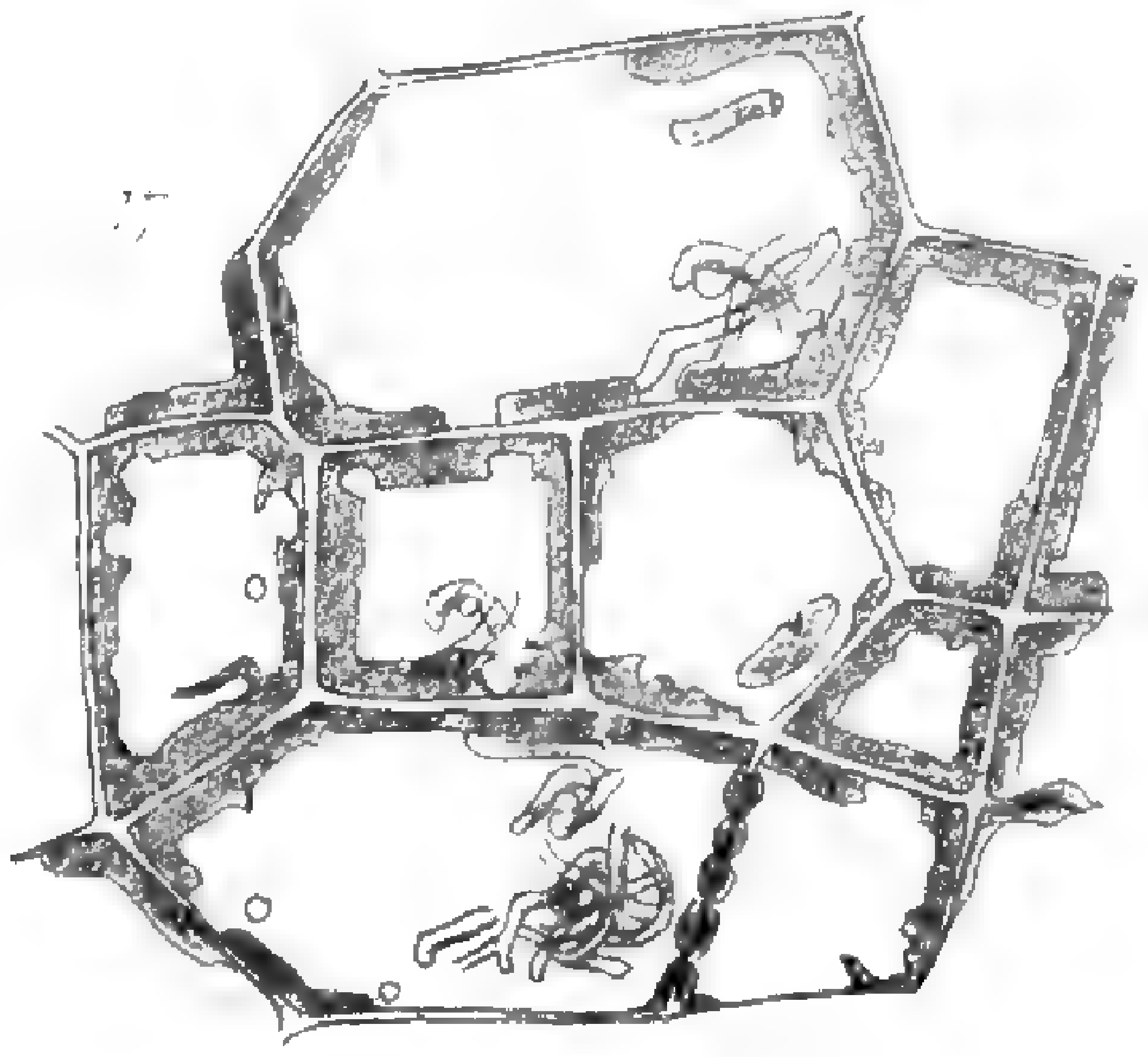

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R.H.B. del. J.N. Fitch lith.

COLLYBIA VELUTIPES

# Notes on the Genus *Nanomitrium*, Lindberg. By ERNEST STANLEY SALMON. (Communicated by J. G. BAKER, F.R.S., F.L.S.)

[Read 2nd February, 1899.]

(PLATE 5.)

IN 1870 Austin (1) published the name *Micromitrium* as a genus for three American Ephemeroid mosses (*M. Austini*, *M. synoicum*, and *M. megalosporum*), with the following diagnosis: "Capsula globosa, immersa, tenera, apiculata vel mutica, clausa, vel pressa in medio horizontaliter fatiscens, brevissime pedicellata vel exacte sessilis. Calyptra minima, subdisciformis, stylidifera, arcte adhærens. Flores synoici. Plantæ . . . *Ephemera* valde referentes distinctæ tamen calyptræ forma et minutie; inflorescentia &c."

In 1874 Lindberg (2) pointed out that Austin's name must give way to the previously published *Micromitrium* of Spruce, and substituted the name *Nanomitrium*, at the same time adding to the genus *Ephemerum æquinoctiale*, Spruce, from the Amazon, and the European *E. tenerum*, Hampe. The last-named species is very rare, and since its original discovery by Breutel at Niesky, Germany, about 1837, has only occurred sporadically in a few places on the Continent. Mitten discovered it in England (Hurstpierpoint, Sussex) in 1854; and it then disappeared until 1896, when Mr. W. E. Nicholson found specimens near Crowborough, Sussex (*see* Journ. of Bot. 1896, p. 479).

A few months ago Mr. Nicholson kindly sent me some fresh plants. On examining the capsules of these specimens of *Nanomitrium tenerum,* I found that certain cells of the wall (which is only one layer thick at maturity) were differentiated in such a way that the capsule possessed a well-marked rudimentary lid. The position and relative size of these differentiated cells, which form a complete zone round the capsule, can be best seen by reference to Pl. **5.** figs. 1 & 2, which were drawn from Mr. Nicholson's Sussex specimens.

The occurrence of a rudimentary lid in *Nanomitrium tenerum* is interesting, as Philibert (5), who lately critically examined the five species of the genus, does not mention any such structure. Limpricht (6) also, in giving the characters of the Order in which he places *Nanomitrium*, says: "Kapsel . . . stets ohne Andeutung eines Deckels."

As it seemed just possible that the occurrence of these cells might be due to an individual variation, and not normal for the species, I examined original specimens collected by Breutel, in Schimper's Herbarium, as well as Husnot's Musci Gall. no. 801, and Mitten's Hurstpierpoint plants—all in the Kew Herbarium. Without exception, the capsules of these specimens possessed the zone of differentiated cells.

The constant presence of a rudimentary lid in *N. tenerum* led me to examine the other species of the genus, in order to ascertain whether it should be considered a generic or specific character. The remaining species are *N. synoicum*, *N. Austini*, *N. æquinoctiale*, and *N. megalosporum*. In *N. synoicum* the rudimentary lid is very well defined; and although I was not able to find any opened capsules, I am inclined to think that a complete separation of the "lid" takes place in nature.

All the ripe capsules that were examined opened on the slightest pressure along the line of narrow cells (Pl. **5.** fig. 3), the upper part of the capsule coming away like a true lid. Moreover, I believe that the narrow cells, in which the dehiscence occurs, are instrumental in bringing about the detachment of the "lid."

At maturity the cell-walls of this layer are extremely thin and slightly disorganized, so that the vertical septa are no longer visible (Pl. **5.** fig. 4). When, on slight pressure, the capsule-wall ruptures, and detaches the regularly circular "lid," portions of these very thin cell-walls of the differentiated zone are found attached partly to the "lid" and partly to the mouth of the capsule. In *N. Austini* (Pl. **5.** fig. 5), also, we find that the capsule possesses the same structure.

Philibert (**5.** p. 51) has mentioned the regular dehiscence of the capsule of *N. tenerum* in the following words: "La capsule . . . semble plutôt se déchirer sur place, quelquefois irrégulièrement, mais souvent aussi suivant une ligne circulaire qui la partage en deux hémisphères égaux, le supérieur se séparant en forme de calotte régulière."

In Austin's original generic description ("capsula . . . pressa in medio horizontaliter fatiscens") the same character is indicated, and the regular dehiscence has even been figured by Sullivant (**7**), at fig. 6 of his plate of *N. Austini*. The presence of a zone of specialized cells satisfactorily accounts for the regular dehiscence which has been observed by the different authors quoted above.

These three species, *N. tenerum*, *N. synoicum*, and *N. Austini*, are, as pointed out by Philibert (**5.** p. 55), closely allied, and it is not surprising, therefore, that the capsules of all exhibit the same structure, and consequently the same regular dehiscence. In *N. æquinoctiale* we find no signs of a rudimentary lid; the capsule-wall is composed of cells which show no differentiation in any part (fig. 6), so that this species is probably truly cleistocarpous. In respect of inflorescence, also, *N. æquinoctiale* differs from the three species mentioned above, which are all synoicous.

Philibert (**5.** p. 57), in his account of *N. æquinoctiale*, says: "Dans toutes les plantes fructifères que j'ai observées je n'ai jamais trouvé que des archégones sans aucun mélange d'anthéridies; et d'un autre côté j'ai observé une plante mâle, naissant isolée sur le protonema . . . Cette espèce serait donc dioïque."

Mitten (**8**), in the original description of the species, thus described the male inflorescence: "Flos masculus e stolonibus confervoideis fœmineo connexis oriundus, vel in ramulo brevi lateralis."

In the Kew specimens of *N. æquinoctiale* (Musci Amaz. et And. 443) the inflorescence occurs in two distinct forms—(1) dioicous, the male plant, formed of five or six leaves, enclosing a few antheridia, springing from the protonema near a female plant (fig. 7); (2) autoicous, the male branch arising laterally from the female stem, just below the perichætium (fig. 9). So far as I have been able to observe in the rather limited material, the two forms of inflorescence occur in about equal numbers.

The male plants that I have seen have always sprung from the protonema, and were not attached by radicles to the female plant (rhizautoicous), so that *N. æquinoctiale* is apparently truly polyoicous (autoicous + dioicous). The cells of the capsule of *N. æquinoctiale* are firmer than those of the three species mentioned above, and the prominent apiculus suggests rather *Ephemerum*.

I was not able to find any calyptræ, although a few young capsules were seen.

This again points to *Ephemerum*, as in this genus the calyptra is frequently fugitive; whilst in *Nanomitrium tenerum*, *synoicum*, and *Austini* the capsules up to maturity are surmounted by the minute, closely appressed calyptra. Mitten (**8**) gives for *N. æquinoctiale* simply the description: "calyptra archegonio styliformi elongato." Philibert does not describe the calyptra.

There remains, now, only *N. megalosporum* to be considered. Here, also, there is no trace of a rudimentary lid (fig. 10). Moreover, from the study of authentic specimens (Musci Appal. 47), I have come to the conclusion that this species does not belong to *Nanomitrium*.

Philibert (**5**. p. 56) remarks that in this species an approach is made in the leaf-areolation towards *Ephemerum*, but considers the plant to be a true *Nanomitrium* for the following reasons:—"La structure du fruit est bien celle du genre *Nanomitrium*. La calyptra est réduite au style, auquel adhérent quelquefois deux ou trois petits lambeaux irréguliers; la capsule est tout à fait sphérique, . . . sa surface supérieure est arrondie ou un peu déprimée, sans aucune trace de pointe . . . L'enveloppe capsulaire . . . est toujours formée . . . d'une seule couche de cellules hexagonales . . . Il n'y a point en réalité de sporange ni de columelle; et cette espèce reste toujours bien séparée par là du genre *Ephemerum*, dont elle s'éloigne d'ailleurs par sa capsule uniformément arrondie, par l'absence des stomates, par l'imperfection de sa coiffe, et par son inflorescence synoïque." My observations do not confirm, in the most important points, those of Philibert's.

In the first place, these specimens showed stomata on the capsule. The stomata, although few in number, appear to be always present; they occur on the upper half of the capsule (figs. 10 & 11), and are exactly similar to those found in *Ephemerum*, e. g. *E. serratum*, Hampe. The capsule-wall consists of more than one layer of cells, and the spore-sac is easy to observe in almost ripe capsules. I consider, therefore, that this species should be called *Ephemerum megalosporum*.

I was not able to see the calyptra. Philibert, as we have seen, considers it right for the genus *Nanomitrium*; but on the other hand Sullivant (**7**. fig. 7 of pl. xi.) figures it as certainly better developed than in *tenerum*, *synoicum*, and *Austini*. If the plant is allowed to be an *Ephemerum*, we must regard it, by reason of the rounded capsule and rudimentary calyptra, as a connecting link with *Nanomitrium*.

We may here consider what have been stated to be the essential characters in which *Nanomitrium* differs from *Ephemerum*. Austin (**1**), in founding the genus, relied on the calyptra and inflorescence. Lindberg (**2**) remarked: "Ex *Ephemero* . . . distinguitur his notis maximi momenti: foliis laxis et difficile emollitis, canaliculatis, superne interdum latioribus, obtuse serratis, omnino enervibus, ædificatis a cellulis conformibus, lævissimis et duplicem lineam circumscribentem habentibus ideoque haud incrassatis, inflorescentia par-synoica, theca maxime leptodermi, fere sine vestigio ullo rostelli, calyptra apici thecæ arcte adhærente, minima et brevissima, ut fere ad stylum solum reducta."

Philibert (**5**. p. 52), as the result of a critical examination of the genus, concluded that "La différence essentielle entre ces deux genres [*Ephemerum* and *Nanomitrium*] paraît donc consister en ce que les espèces qui appartiennent au premier ont toujours un sporange distinct, tandis que celles du genre *Nanomitrium* en sont dépourvues"; also remarking (*loc. cit.* p. 57): "Le genre *Nanomitrium*, quoique bien distinct du genre *Ephemerum* par la structure du sporogone, n'en serait pas cependant séparé par des limites aussi tranchées que le supposait Lindberg: d'un côté le *N. megalosporum* se rapproche des Ephemera par le tissu des feuilles et la grosseur des spores, et d'un autre côté le *N. æquinoctiale* s'en rapprocherait par l'inflorescence."

Limpricht (**6**. p. 160), in his key, separates *Ephemerum* from *Nanomitrium* by the presence of stomata on the capsule of the species belonging to the first genus; also remarking on *Nanomitrium* (*loc. cit.* p. 162), "zur Reifezeit Columella und Sporensack *völlig* resorbirt"; and on *Ephemerum* (*loc. cit.* p. 164), "Columella innerhalb des Sporensackes resorbirt, Sporensack bleibend und an beiden Polen mit kurzen Säulchen, den Resten der Columella, die den zur Reifezeit noch vorhandenen Luftraum durchsetzen."

*N. megalosporum* shows the artificiality of the two genera as at present defined, for in this species the capsule has the shape, and perhaps the calyptra, of *Nanomitrium*, while its structure is that of *Ephemerum*.

I would propose that the genus *Nanomitrium*, as we now know it, be restricted to *N. tenerum*, *N. synoicum*, and *N. Austini*, and that the essential character separating it from *Ephemerum* be the presence of a strongly leptodermous capsule (with a wall at maturity formed of only a single layer of cells), possessing a rudimentary lid, as shown by the occurrence of differentiated cells, by which a regular dehiscence is effected. *N. megalosporum* must be transferred to *Ephemerum*, and probably *N. æquinoctiale* also, although more observations are desirable to settle this last point.

There remains to be considered the systematic position of the two genera, and some of the facts mentioned above help, I think, to decide this question.

Limpricht, in his admirable "Die Laubmoose," has unfortunately kept up the unnatural Tribe *Cleistocarpæ* in his classification. *Nanomitrium* and *Ephemerum* are placed there in the Order *Ephemeraceæ*; the former will now have to be removed, as the Order is characterized by possessing a capsule "stets ohne Andeutung eines Deckels."

It is even doubtful if Limpricht can include *Nanomitrium* in the *Cleistocarpæ* at all, as this author expressly states as the most important character of the *Cleistocarpæ*, "dass die . . . Kapsel sich niemals mittelst eines Deckels öffnet, auch wenn dieser der Anlage nach vorhanden ist."

But we can safely, I think, put aside the idea that either *Nanomitrium* or *Ephemerum* will find a permanent place in the *Cleistocarpæ*; for the maintenance of this tribe leads to the obviously unnatural separation of such genera as *Physcomitrium* and *Physcomitrella*. We need consider, therefore, only those schemes of classification in which cleistocarpous genera are considered as being composed of degraded or simpler forms belonging to various stegocarpous Orders. *Nanomitrium* has already been well placed by Lindberg (**2**) in the *Funariaceæ*.

The possession of a rudimentary lid further justifies the position of this genus in an Order in which stegocarpous genera occur, and tends to give it a place near *Physcomitrella*, as in that genus (which has been generally regarded as cleistocarpous) Mrs. Britton (**9**) has lately recorded a regular dehiscence of the capsule.

From the preceding remarks it is clear that *Ephemerum* and *Nanomitrium* are too closely allied to be separated in different Orders. This has been felt by many authors. Limpricht, for instance, includes both in *Ephemeraceæ*; Paris, in his 'Index Bryologicus' (**10**) has even sunk *Nanomitrium* in *Ephemerum*.

Lindberg wavered as to the proper systematic position of *Ephemerum*. At first (**3**) this author placed it in the section *Funarieæ* of *Funariaceæ*, but later (**2**. p. 410) wrote:—"*Ephemerum* vix inter *Funariaceas* est collocandum, sed potius inter *Pottiaceas* in serie *Tortulearum* (?)"; and finally, in the classical 'Musci Scandinavici' (**4**), we find *Ephemerum* placed in the *Tortulaceæ* and associated with *Barbula*.

Braithwaite (**11**) has followed Lindberg as regards the placing of *Ephemerum* in *Tortulaceæ*, but considers that its affinity appears to be greatest with the genus *Phascum*, "both in the calyptra and areolation."

Dixon, on the other hand, places *Ephemerum* in the *Funariaceæ*, for, it appears to me, very convincing reasons. This author says (12): "I have united *Ephemerum* with the *Funariaceæ*, as despite their near resemblance to *Acaulon* they appear to be quite as closely related, through *Physcomitrella*, with that Order, and the areolation is rather Funarioid than Pottioid." Also on page 268: "The plants composing this and the last genus [*Nanomitrium* and *Ephemerum*] are connected with the higher *Funariaceæ* through *Physcomitrella* and *Physcomitrium*."

We may now, I think, look upon *Nanomitrium* as securely placed in the *Funariaceæ*, and at the same time must consider that *Ephemerum* is linked, through the intermediate *E. megalosporum*, to the same Order.

*Note.*—Since writing the above, I have seen the last part of Goebel's 'Organographie der Pflanzen' (2 Th. 1 Heft, 1898), and find that the capsule of *Nanomitrium tenerum* has been recently investigated by this author, with the special object of ascertaining if a columella is present.

Goebel has found that a columella exists in the earlier stages of the development of the capsule, but that, when the capsule is ripe, the columella, together with all the cells of the amphithecium except the external layer, becomes absorbed. Also, what is specially interesting, the presence of the differentiated cells of the capsule-wall, above referred to, is clearly indicated.

In the figure of the longitudinal section of the ripe capsule (*loc. cit.* fig. 253) two very small cells are shown, which are described in the explanation of the figure as the annulus.

[An earlier account of Goebel's investigations on *N. tenerum* appears in Flora, Bd. lxxx. p. 463 (1895). Here a figure is given of the capsule, showing the zone of differentiated cells, which is described as the annulus, and the following remarks are made: — "*Nanomitrium* besitzt indess einen Deckel und einen " Ring " in der einschichtigen Sporogonwand. . . . An einer Anzahl reifer Kapseln war der Deckel an der Ringstelle (die, wie Fig. 3 zeigt, durch niedrigere Zellen gekennzeichnet ist) abgebrochen; gelegentlich mag auch der Ring unvollständig sich ausbilden und dann die Kapselwand bei der Reife unregelmässig zerreissen." The other points of my paper are not touched upon.—E. S. S., February 21st, 1899.]

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## EXPLANATION OF PLATE 5.

Fig. 1. *Nanomitrium tenerum*, capsule showing zone of differentiated cells, × 150.

2. *N. tenerum*, apex of capsule, × 255.

3. *N. synoicum*, capsule dehiscing along the line of the differentiated cells, × 150.

4. *N. synoicum*, part of wall of a ripe capsule at line of dehiscence, × 255.

5. *N. Austini*, capsule dehiscing as in fig. 3, × 150.

6. *N. æquinoctiale*, capsule, × 150.

7. „ „ male plant, seated on the protonema, × 68.

8. Antheridium of same, × 150.

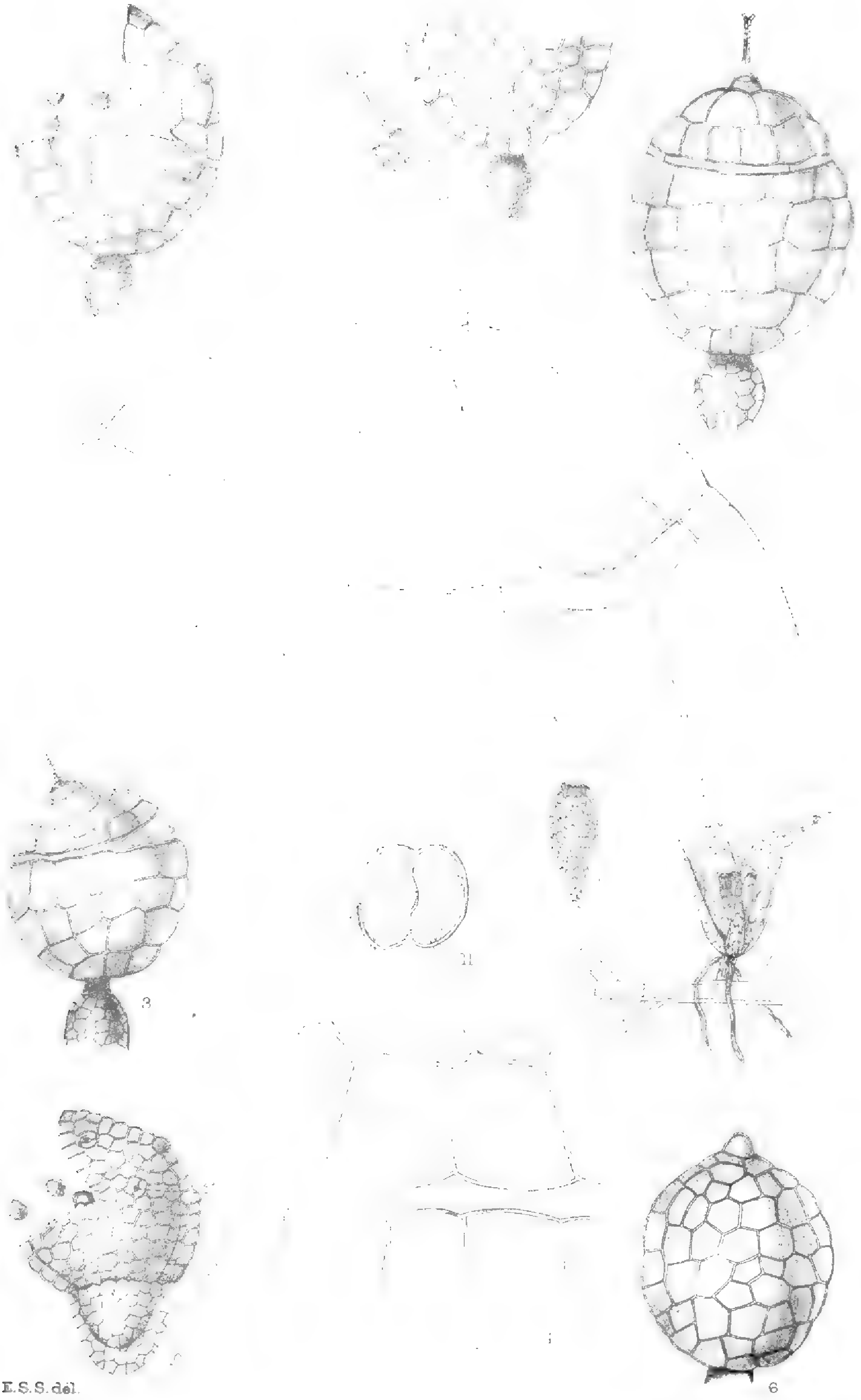
9. *N. æquinoctiale*, autoicous form of inflorescence, × 150.

10. *N. megalosporum*, capsule opening irregularly on pressure; *st.*, stoma; *sp.*, spore-sac, × 68.

11. Stoma of same, × 400.

Salmon.

LINN. SOC. JOURN. BOT. VOL. XXXIV. Pl. 5.



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CAPSULE OF NANOMITRIUM.

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# The Botanical Results of a Journey into the Interior of Western Australia; with some Observations on the Nature and Relations of the Desert Flora. By SPENCER LE MARCHANT MOORE, B.Sc., F.L.S.

[Read 17th November, 1898.]

OUR expedition landed at King George's Sound in the middle of December, 1894. During the few hours intervening between the liner's arrival and the departure of our train for Perth, I rambled about in the neighbourhood of Albany, admiring the astonishing variety in its vegetation for which this corner of Australia is so celebrated. True, indeed, it was late in the season, and much of the flowering was already over; yet even then it would have been easy, at the cost of a few hours' diligent labour, to make a collection by no means insignificant, had such a course, in view of the thorough exploration of previous travellers, been deemed for any reason desirable. Beyond the granite hills of Albany lies a wide stretch of low marshy land which might still be worth a botanist's attention; but one soon passes this and enters the "bush"—a type of country extending, with more or less variation, till the Darling ranges are reached. In spite of the large grants of Crown land made over to the Railway Company *, and the inducements held forth to settlers in the districts traversed by the Line, development in this part of the Colony has not proceeded apace, and not till you arrive at Katanning are there many signs of agricultural enterprise. Here, however, as at Beverley and especially at York, the farmer is more in evidence. But, unless the summer of 1894 was exceptional—happily I believe this to have been the case—he must have many difficulties to contend against. Loiterers at the wayside stations had doleful stories to tell of the drought—stories too often confirmed up to the hilt as we passed through splendid-looking country so cruelly parched that the sight of it was enough to make one's heart ache. But all this was changed in the Darling ranges, where the numerous wood-cutting settlements imparted a welcome tone of prosperity to the scene.

As we travelled up to Southern Cross from Perth, night soon hid the country from our view, and not until we were near our destination did the daybreak restore it. We had traversed the Jarrah forest-region the evening before, and were now passing over red soil through well-wooded country of which the vegetation consisted, in its main feature, of gum-trees [*], much lower in stature and sparser in habit than the giants of the Jarrah region. When, a few days afterwards, we started from Southern Cross with a small camel-train for Siberia, situated some 120 miles in a north-easterly direction, the gum-trees were left behind a few miles out of Southern Cross, and we entered a broad stretch of country thickly covered with shrubby vegetation, while the soil had changed from red to white or yellow, an indication of underlying granite rocks. This shrub-bearing region with pale soil extends to Siberia, except for some intervening treed belts with red soil and some salt lakes and "salt-bush" flats. At intervals along the route one passes large granite outcrops, where alone water is to be had, if at all. The drought was very severe when we passed through, and we began to be seriously apprehensive of disaster; but, thanks to a timely thunderstorm, our journey was performed without further difficulty. In coming down by railway from Coolgardie more than eighteen months afterwards, I passed through the same wide belt of shrubbed land, of which the chief characteristic is the abundance of Myrtaceæ belonging, for the most part, to the tribe *Chamælaucieæ*. Among the few plants secured in this part of the journey may be mentioned *Marianthus lineatus*, F. Muell., *Cassia artemisioides*, Gaudich., *Loudonia aurea*, F. Muell., *Kunzea sericea*, Turcz., *Olearia ramulosa*, Benth., and the new species *Phyllota lycopodioides*, *Acacia sibirica*, and *Helichrysum puteale*. One of the most striking features about the vegetation of the West Australian desert, or at least of those parts of it visited by me, is the absence of the well-known "Black-Boy" (*Xanthorrhœa Preissii*, Endl.): except for a narrow belt between Southern Cross and Siberia, where a few diminutive individuals, probably of this species, were seen, and a similar belt up country between Yilgangie and Uladdie, this plant, so abundant nearer the coast, was not met with east of Southern Cross.

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* This railway, together with the land-concessions enjoyed by it, has been recently purchased by the West Australian Government.

From Siberia we made our way, *viâ* Goongarrie or Ninety Mile, to Mount Margaret. The country between Siberia and Goongarrie is similar to that at Southern Cross, the soil being red, while gum-trees are the most prominent element in the vegetation—it is, in short, an auriferous zone. But no sooner is the salt lake at Goongarrie crossed, than an entire change takes place in the vegetation. From this point onward gum-trees are few in number, and for the most part restricted to the banks of creeks, and their place is taken by "Mulga" (*Acacia*), by Eremophilas, Proteaceæ, Casuarinas, &c. The general hue of this vegetation is a dark olive-green, and this renders the scene dreary to a degree. There is, however, one alleviation, inasmuch as the bright green foliage of that beautiful tree, the Currajong (*Sterculia diversifolia*, G. Don), rare and seldom seen further west, often refreshes the traveller's eye in this back country. Goongarrie is situated close to the thirtieth parallel of South latitude; and as the change in the vegetation is here so abrupt, I have, as will afterwards be shown in more detail, assumed this parallel as marking the division between two floras. Whether the line should run due east and west is a moot point —its trend is probably north-west or north-north-west. I find, however, by proceeding on the just-mentioned assumption and comparing all available records, a considerable percentage of the plants found to the south of the thirtieth parallel are different, specifically or generically—generally the former—from those having their habitat north of it. The primary difference between the two regions, the rarity of gum-trees in the one and their abundance in the other, is a fact well known to mining men, one of the most serious drawbacks to mining enterprise in the northern districts being the scarcity of suitable timber, while its abundance south of the thirtieth parallel, as at Southern Cross, Coolgardie, Kalgoorlie, and other centres, is a fact well known to all *.

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[*] These gum-trees appear to be *Eucalyptus salmonophloia*, *E. redunca*, &c.

From Mount Margaret a short expedition was made to "the table-topped mountain," a low elevation a few miles to the north-east, which has by some, apparently in error, been identified with the hill called by Sir John Forrest, Mount Weld. The camp was then fixed at the Hawk's Nest, situated at the foot of a diorite range of low elevation, the scene of a then almost deserted mining encampment. From this place, I, accompanied by our Afghan and the camels, made for Coolgardie *viâ* Yilgangie and Uladdie, with the object of procuring a fresh supply of food. On my return to the Hawk's Nest, we started for the diggings near Lake Darlôt; but the country being very dry, we remained a few days camped at Mackenzie's well, fourteen miles north-east of Mount Margaret, as a long waterless stage intervened between us and our destination. A timely storm enabled us to push forward, and, passing the Darlôt diggings, we crossed the salt lake Darlôt, and made for some high granite rocks fourteen miles to the northward, where there was an abundant supply of water. At that time provisions at Darlôt were at famine prices, and we consequently found ourselves forced to relinquish our intention of travelling further north; and, making a track through the bush, we returned to our main encampment at Mackenzie's well. From here the whole party set out along the Darlôt road, with the object of camping at a creek where there was plenty of water; and it was during a stay of three weeks at this last camp, while some of the party were away on a distant expedition, that I was able to do a little collecting. Here I found *inter alia* the pretty little *Ionidium floribundum*, Walp., in some plenty; also *Abutilon Fraseri*, Hook., and its var. *parviflora*, Benth., *Dodonæa filifolia*, Hook., *Acacia aneura*, Benth., *Micromyrtus imbricata*, R. Br., *Canthium latifolium*, F. Muell., *Pluchea Dentex*, R. Br., *Eremophila leucophylla*, Benth., and *E. latifolia*, F. Muell., and a curious dwarf variety (var. *rosulata*, nob.) of *Nicotiana suaveolens*, Lehm., &c. Nor was I unsuccessful in the search for new species, e. g., *Eremophila metallicorum*, *Hemigenia exilis*, and the pretty rose-flowered *Velleia rosea.*

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* This difference between the nearer and more distant parts of the desert was first brought to my notice by Sir John Forrest in an interview I had with him before leaving for the Interior. I mention this for the purpose of emphasizing a fact which had evidently impressed itself deeply, during the early pioneering days when he first won his spurs, upon the mind of a man who himself makes no special claim to being a botanist.

We had been five months on our travels, and our stock of provisions getting low, our faces were turned to the south. Travelling by way of Doyle's well, Mount George, and Goongarrie, we arrived at Coolgardie on June 27th, and after a short delay there, fixed our camp at Gibraltar, sixteen miles south-west of the mining capital. It was now the depth of winter; the days were cool and the nights intensely cold. A considerable quantity of rain had fallen, and herbaceous vegetation showed itself in fair abundance, and as spring approached the desert began to wear quite a pleasing appearance. Grasses threw up their haulms, and lowly Crucifers and Umbellifers, Calandrinias, Zygophyllums, Erodiums, Droseras, Goodenias (*Goodenia heterophylla* and *Goodenia mimuloides*, the latter new), Amaranthaceæ, &c., came into flower. But the chief honours of this spring vegetation are won by lowly Compositæ of the tribe Helichyseæ. Some of these cover large spaces of ground literally in sheets—now yellow (*Waitzia corymbosa*, Wendl., *Helipterum Haighii*, F. Muell.), now white (*Helipterum rubellum*, Benth., and *Fitzgibboni*, F. Muell., *Cephalipterum Drummondii*, A. Gray) or pink (*Schœnia Cassiniana*, Steetz); while in the neighbourhood of granite outcrops the white or pink *Helipterum Manglesii*, F. Muell., and the yellow *Podolepis pallida*, Turcz., and *Helichrysum semipapposum*, DC., are conspicuous at this time of year. This wealth of colour is, however, of but short duration; daily the sun mounts higher in the heavens and all lowly vegetation dries up and vanishes, so that by the end of October the ground has become bare as a monk's tonsure, and you wonder how anything herbaceous could have contrived to exist there.

One point has been left unnoticed, namely, the occurrence of the so-called "Spinifex" (*Triodia irritans*, R. Br.). This is not met with in any quantity south of Mount Margaret, but further north one passes stretches of country of which it is a prominent feature. I saw nothing suggestive of the term "spinifex desert" which one finds printed on the maps; for after, at most, a few miles of "spinifex," the "bush" reappears. What there may be still further north and north-east, of course I cannot say; but there seem to be grounds for doubting whether any very large and continuous area of which the "spinifex" is the characteristic plant exists in the interior of the Colony. Nevertheless, its frequency in the north, when we bear in mind the comparative rarity of its occurrence south of the thirtieth parallel, is a matter worthy of remark.

It has already been stated that spring is the time of flowering for the herbaceous vegetation, and to a large extent this is true of the shrubs and trees also. Some of the latter, however, put forth their flowers at other times of the year; while a few, such as the Quandong and *Scævola spinescens*, R. Br., will flower almost the whole year round. In the moister coast-region, likewise, most of the plants are spring or early summer flowerers *, and for the obvious reason that the summer and autumn are very hot and the air so dry that flowers are then liable to become desiccated. The flowering of plants is also dependent upon the chance of rain. I was particularly struck with this fact when far up country, upon coming into some district recently visited by a storm, and finding the shrubs in flower there, while in neighbouring districts not so favoured—the storms are usually local, often extremely so—flowers were not to be seen. Curious, too, is the paucity of the flowers, and the rapidity with which they dry up, often, to all appearance, before pollination has been effected. But this is only one sign of the desperate struggle for existence which these tenants of the desert solitudes are forced to maintain. Trees and shrubs quite or all but dead are frequent; and it is no exaggeration to say that in some districts, where rain has not fallen for a considerable time, fully fifty per cent. of the vegetation may be on the verge of destruction. This remark applies chiefly to the country north of the thirtieth parallel; south of that line the gum-trees, ever fresh, no matter how long the drought may have lasted, give an entirely different appearance to the scene.

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* In his essay on the Australian Flora (Flora of Tasmania, Introd. Essay, p. xxix), Sir Joseph Hooker combats the then prevalent idea that the vegetation of the island-continent is entirely without analogy in other parts of the world. Among other arguments advanced in support of his contention, we find it

Go where you will, the quantity of vegetation is simply marvellous, when one bears in mind the extremely small rainfall. The best way to obtain a clear idea of this is to climb a low hill, or one of the "gnamma" rocks so frequently met with. From such a point of view the clearness of the atmosphere enables the eye to range over long distances, and one gets the impression of a densely afforested country, variegated here and there, perhaps, by a glistening salt lake, with perhaps a "salt-bush" flat in the foreground. Admiring such a scene as this, I thought of the Matto Grosso "cerrados," which have nothing like so much shrubby and arboreous vegetation, and scarcely so high an average summer temperature, though the quantity of rain which falls upon them is ten times as great. This wonderful adaptation of Australian plants to an extreme climate I shall again refer to later on.

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averred that in Australia, as elsewhere, a common order of flowering prevails, the Orchidea putting forth their blossoms in spring, the Leguminosæ in summer, and the Compositæ in autumn. Whether, supposing the order of flowering to be as stated, the argument has any value, may be a matter of opinion; the point to emphasize here is that, as applicable to the West Australian flora, the statement is scarcely borne out by facts.

I propose to give first a list of the plants collected by myself. Then will follow statistics of the Desert flora obtained from all available sources. Xerophily and homoplasy will next be briefly referred to; and after this some remarks will be made on the distribution of Desert plants in relation to the soil.

The first set of the plants, it may be added, is at the British Museum. The second and third sets have been sent to Columbia College, New York, and the Kew Herbarium respectively.

## LIST OF PLANTS *collected in the West Australian Interior; with descriptions of the new species.*

### ANGIOSPERMÆ.

### DICOTYLEDONES.

### CRUCIFERÆ.

BLENNODIA BREVIPES, *F. Muell.* Near Coolgardie, August. Flowers white.

B. CARDAMINOIDES, *F. Muell.*, var. MICROCARPA, *nob.* Near Coolgardie, August. A small form only 8 cm. high, with short pods not exceeding 6 mm. in length. Flowers yellow.

ALYSSUM LINIFOLIUM, *Steph.* Environs of Coolgardie, August.

STENOPETALUM ROBUSTUM, *Endl.* A common little herb in springtime at Gibraltar near Coolgardie. Flowers brown-yellow.

S. SPHÆROCARPUM, *F. Muell.* Near Coolgardie, August.

S. LINEARE, *R. Br.* Near Coolgardie, August.

MENKEA COOLGARDIENSIS, *S. Moore, in Journ. Bot.* XXXV. (1897) p. 162. Near Coolgardie, August.

LEPIDIUM PAPILLOSUM, *F. Muell.* Near Coolgardie, August. A small form, only 5–10 cm. high.

L. RUDERALE, *Linn.* Near Coolgardie, August.

RAPHANUS SATIVUS, *Linn.* Bullabulling rocks, September. Almost certainly introduced by teamsters.

### VIOLACEÆ.

IONIDIUM FLORIBUNDUM, *Walp.* Between Wilson's creek and Lake Darlôt and elsewhere in that district, April and May. Between Coolgardie and Gibraltar, August. A pretty little subshrub not infrequently met with, 2 feet or so high. Flowers much like those of *Viola tricolor*, but smaller.

### PITTOSPOREÆ.

PITTOSPORUM PHILLYRÆOIDES, *DC.*, var. MICROCARPA, *nob.* Salt-bush plain south of Doyle's well, June (flowers and fruit). Fruits smaller than those of type, oblong-ovoid not flattened, and with only 1–4 seeds. A small tree or tall shrub up to 12 feet or so high, the branches weeping.

MARIANTHUS LINEATUS, *F. Muell.* Between Southern Cross and Siberia soak, January (flowers and fruit). An erect shrub about 2½ feet high. Flowers yellowish white, with chocolate stripes. Capsules relatively larger and narrower than those of the type.

In the report of the Elder Expedition this plant is alluded to as a twiner.

### FRANKENIACEÆ.

FRANKENIA PAUCIFLORA, *DC.* Gibraltar, September. A subshrub with pink flowers.

### CARYOPHYLLEÆ.

SILENE GALLICA, *Linn.* Bullabulling, September. A well established alien.

DRYMARIA FILIFORMIS, *Benth.* Near Coolgardie, August. A rather common little herb in springtime.

### PORTULACEÆ.

CALANDRINIA PYGMÆA, *F. Muell.* Bullabulling, September.

C. CALYPTRATA, *Hook. f.* Near Coolgardie, August. Here a small, indeed usually minute, herb.

### HYPERICINEÆ.

HYPERICUM JAPONICUM, *Thunb.* Donkey rocks, between Goongarrie and Mt. Margaret, June.

### MALVACEÆ.

LAVATERA PLEBEIA, *Sims.* Between Uladdie soak and Yilgangie claypans, March. Near Coolgardie, August.

The Coolgardie specimens are remarkably small, only 10–12 cm. high, and proportionately diminished all round.

MALVA PARVIFLORA, *Linn.* Bullabulling, September. An undoubted introduction.

PLAGIANTHUS REPENS, sp. nov. Suffruticosa, repens, pubescens, foliis parvis longipetiolatis rotundato-ovatis vel suborbicularibus rarius ovatis plerisque inæqualiter 5-lobulatis, floribus parvis axillaribus solitariis vel breviter racemosis subsessilibus hermaphroditis, calyce tubuloso 5-lobato, petalis calycem subæquantibus vel paullo excedentibus, staminibus 10, ovarii loculis 5, stylis filiformibus stamina superantibus.

*Hab.* Crescit juxta Gibraltar, mens. Oct. florens et fructificans.

Caules sat validi, crebro ramosi, subtus demum puberuli. Foliorum lamina 0·5–1·0 cm. long. et lat., basi truncata vel obtusa; lobi circa 0·15 cm. long., deltoidei, obtusi; petioli usque ad 0·8 cm. long., plerumque vero breviores; stipulæ lineares, 0·25 cm. long. Calyx 0·45 cm. long., circa 0·5 cm. diam., 5-angulatus; lobi ejus deltoidei, obtusi. Petala late oblonga, obtusissima. Ovarium glabrum. Styli elongati, deorsum geniculati. Carpella matura 5, calyce inclusa, puberula, apice subito elevata ibique obtusa. Semina atra, scrobiculata, 0·13 cm. long.

This is evidently closely allied to *P. diffusus*, Benth. The chief points of difference are the indumentum, the subsessile hermaphrodite flowers, and the invariable decandry.

SIDA PETROPHILA, *F. Muell.* Wilson's patch between Mount Margaret and Lake Darlôt, May. Plain south of Doyle's well, June. A small subshrub, 2–3 feet high. Flowers yellow.

S. sp. indet. Near Coolgardie, August. A small yellow-flowered subshrub.

The specimens, which are in early flower, have the general appearance of *S. calyxhymenia*, J. Gay, the calyx of which is strongly accrescent, whereas that of *S. petrophila*, F. Muell., which the present plant also resembles, is scarcely so at all. For this reason I am unable to definitely name the specimens.

ABUTILON CRYPTOPETALUM, *F. Muell.* Near Siberia soak, January. A lowly erect subshrub, about 18 inches high, sparingly branched. Flowers pale yellow.

A. FRASERI, *Hook.* Between Mackenzie's well and Lake Darlôt, April. A small yellow-flowered subshrub.

A. FRASERI, *Hook.*, var. PARVIFLORA, *Benth.* Wilson's patch, between Mount Margaret and Lake Darlôt, May. Flowers yellow, then white.

HIBISCUS KRICHAUFFIANUS, *F. Muell.* Between Pendinnie soak and Mt. Margaret, March. Subshrub, a foot high. Flowers pale purple.

### STERCULIACEÆ.

STERCULIA DIVERSIFOLIA, *G. Don.* (Brachychiton Gregorii, *F. Muell.*). This, the Kurragong tree, is tolerably abundant in various districts of the Interior, especially north of Goongarrie. It is much rarer in the neighbourhood of Coolgardie; thus, during all the months I was at Gibraltar, but one was seen there, and none elsewhere except at Bullabulling, where there are a few close to the rocks.

RULINGIA COACTA, sp. nov. Suffrutex, caulibus et foliis et alabastris molliter villosulo-tomentosis, foliis subsessilibus lineari-oblongis obtusissimis crenatis bullulatis deinde planis, stipulis setaceis integris villosulis, cymis subsessilibus oppositifoliis terminalibusve plurifloris congestis quam folia brevioribus, alabastris pentagonis obtusis, calycis lobis oblongo-ovatis obtusissimis, petalis parvis quam sepala multo brevioribus basi planis vel leviter concavis revolutisve, ligula parva vel vix vel omnino obsoleta, staminibus omnino liberis, staminodiis stamina multo excedentibus liberis.

*Hab.* Repperi inter Coolgardie et Gibraltar mens. Sept. flores albos proferentem.

Ascendens, usque ad 30·0 cm. alt., plerumque humilior et nonnunquam usque ad 15·0 cm. abbreviata. Radix rigidus, fere rectus, sparsim ramosus, sursum 0 25 cm. diam. Caules rigidi, teretes, ætate glabri et fulvido-rufi. Folia 2·0–2·5 cm. long., 0·4–0·6 cm. lat., deinde pagina superiore pubescentia; petioli 0·1–0·2 cm. et stipulæ 0·4-0·7 cm. long. Cymæ paucifloræ, circa 2 cm. diam. Bracteæ lanceolato-obovatæ, acutæ, pedicellos excedentes, extra villosulæ. Flores vix usque ad 1·0 cm. diam. Calycis lobi 0·4 cm. long., extra mox molliter pubescentes. Petala vix ultra 0·2 cm. long, extus villosula; ligula laminam paullo superans, linearis, obtusa, vel plus minus abbreviata et petalum totum ad laminam minutam ovatam vel ovato-lanceolatam planam sæpe reductum. Filamenta 0·1 cm. long., basi dilatata ibique libera. Staminodia omnino inter se libera, lanceolata, vix 0·3 cm. long., villosula. Ovarium glabrum, granulatum. Capsulæ ignotæ.

This plant has given me much trouble, mainly on account of its petals. It is, in fact, a synthetic type, since the differences in the petals characteristic of the tribes Buettnerieæ and Lasiopetaleæ are met with here, and *even in the same flower*. The petals typical of the former tribe are prominent organs, with a large concave base and an elongated, more or less linear appendage or lamina: those of the Lasiopetaleæ, if present at all, are small and scaly, and without trace of a lamina. The petals of *Rulingia coacta* are never of any size, but the lamina is sometimes relatively well-developed, and this side by side with petals which may show but a trace of a lamina or even be reduced to a simple scale. In all other respects, with the trifling exception that the staminodes are quite free at the base, instead of being connate and adnate to the stamens, the present plant is a typical *Rulingia*; but, inasmuch as the union is very slight in the case of *R. salvifolia*, Benth., I cannot consider this to warrant the establishing of a new genus in an order already, to my judgment, too much divided up generically.

Owing to absence of fruit, it is impossible to indicate the affinity of *R. coacta*. At first sight it looks not unlike *R. pannosa*, R. Br., but the leaves are smaller and differently shaped, and the inflorescence is more congested. The floral peculiarities above mentioned are, of course, weighty points of divergence.

This plant was found only in one place, which a bush-fire had passed over some time previously. *Plagianthus repens* (p. 179) also grows here, and I saw it nowhere else.

RULINGIA LOXOPHYLLA?, *F. Muell.* Near Kilkenny soak, June. An ascending subshrub, up to 3 feet or so. Flowers yellow.

The specimens to hand have buds merely, so that I find it impossible to name this without a query.

KERAUDRENIA INTEGRIFOLIA, *Steud.* Siberia soak, January (in fruit). Between Uladdie soak and Yilgangie claypans, March (in fruit). Nine-mile rocks between Coolgardie and Gibraltar, September.

In the two former localities a small subshrub up to 2 feet high, with pale purple or lavender calyces. Near Coolgardie a shrub of 3 to 4 feet, the calyces blue. Its large, brightly coloured calyces give this plant a very striking appearance. It was seen only in the soil of decomposed granite.

### ZYGOPHYLLEÆ.

TRIBULUS TERRESTRIS, *Linn.* Between Uladdie soak and Yilgangie claypans, March.

ZYGOPHYLLUM APICULATUM, *F. Muell.* Common in the Coolgardie district in springtime. Flowers yellow.

Z. IODOCARPUM, *F. Muell.*, var. BILOBUM. Near Coolgardie, August. Flowers yellow.

Z. FRUTICULOSUM, *DC.* Near Ninety-mile lake, north of Coolgardie, June. A small yellow-flowered subshrub.

Z. FRUTICULOSUM, *DC.*, var. PARVIFLORA, *nob.* Near Coolgardie, August. Between Coolgardie and Gibraltar, October. Apparently the same variety was obtained by the Elder Expedition people.

### GERANIACEÆ.

ERODIUM CICUTARIUM, *L'Hérit.* Near Coolgardie. Common in August and September.

E. CYGNORUM, *Nees.* Near Coolgardie, August.

OXALIS CORNICULATA, *Linn.* Siberia soak, January. The specimens were not kept.

### RUTACEÆ.

PHEBALIUM TUBERCULOSUM, *Benth.* A shrub about 4 feet high, with white flowers near Coolgardie, with pink flowers near Gnarlbine.

### STACKHOUSIEÆ.

STACKHOUSIA VIMINEA, *Sm.* Donkey rocks between Goongarrie and Mt. Margaret, June. Gibraltar, September.

STACKHOUSIA FLAVA, *Hook.*, var. Donkey rocks, June. This variety has pubescent bracts and floral axes. The petals also are somewhat blunter than are those of type specimens. Might possibly be regarded as a new species.

Another *Stackhousia*, probably typical *S. flava*, Hook., is rather abundant on the Nine-mile rocks near Coolgardie, but, as no specimens are to hand, I must somehow have omitted to press any.

The *Stackhousiæ*, so far as my observation goes, grow only on decomposed granitic soil.

## RHAMNACEÆ.

POMADERRIS FORRESTIANA, *F. Muell.* A shrub about 3 feet or so, with white flowers, near Gnarlbine, September. A lowly shrub, up to 2 feet, with brown flowers, between Coolgardie and Gnarlbine, October. I can see no essential difference between the two.

TRYMALIUM MYRTILLUS, sp. nov. Crebro ramosa, ramis tenuibus mox glabris, foliis parvis oblanceolatis vel anguste oblanceolato-obovatis in petiolum brevem sensim angustatis subtus molliter appresse pubescentibus, cymis plurifloris folia excedentibus, floribus modicis pedicellatis, pedicellis tandem calyces excedentibus una cum his breviter tomentosis, bracteis ovatis, ovario 3-loculo.

*Hab.* Viget prope Coolgardie, ubi mens. Aug. floret.

Frutex ultrametralis. Ramuli flexuosi, foliorum evanidorum reliquiis persistentibus crebro induti, cinerei, circa 0·1 cm. crassi. Stipulæ ovatæ vel ovato-lanceolatæ, scariosæ, circa 0·075 cm. long. Folia subcoriacea, pleraque 0·5–0·7 cm. long., obtusissima vel emarginata, supra brevissime pubescentia, subtus pallida. Cymæ tandem usque ad 1·5 cm. long., pleræque vero breviores. Bracteæ stipulis conformes, extra pubescentes. Alabastra 5-gona. Flores circa 0·2 cm. diam., lutescenti-albi. Calycis lobi late ovati, obtusi. Petala quam calyx breviora, cucullata, brevissime unguiculata, integra. Stamina parva, deinde erecta. Capsula nondum obvia.

A plant with the habit of *T. Wichuræ*, Nees, to which it is doubtless closely allied. The leaves, however, are somewhat different in shape, and the cymes longer than the leaves and with more flowers. The three-celled ovary may be mentioned among other points of difference.

STENANTHEMUM LEUCOPHRACTUM, *Reiss.* Between Wilson's creek and Lake Darlôt, May. A small branching subshrub about 2 feet high. Flowers yellow.

CRYPTANDRA PARVIFOLIA, *Turcz.* Near Coolgardie, September.

C. (§ WICHUREA) PETRÆA, sp. nov. Spinosa, sparsim ramosa, ramis crispe pubescentibus, foliis minutis linearibus obtusis marginibus revolutis minute pubescentibus, floribus parvis pedunculatis, calyce subrotato alte lobato glabro, ovario infero.

*Hab.* Crescit apud petras graniticas "Donkey rocks" nuncupatas, inter Goongarrie et Mt. Margaret.

Suffrutex parvus, ⅔-metralis. Rami subteretes, circa 0·2 cm. diam., cinerascentes, dein glabri et rimosi. Spinæ rectæ vel leviter decurvæ, modicæ, vix 1·0 cm. long., apicem versus attenuatæ, nonnunquam foliigeræ. Folia circa 0·3 cm. long., basi obtusa, petiolis brevissimis fulta. Flores solitarii vel in glomerulos parvos dispositi. Bracteæ minutæ, albido-ciliatæ. Pedunculi circa 0·2 cm. long., glabri. Alabastra obtusissima, 5-gona. Flores 0·4 cm. diam., albi. Calycis lobi ovati, obtusi, 0·13 cm. long. Petala calycem subæquantia, longe unguiculata, late ovata, concava. Stamina primo petalis abscondita dein libera. Discus annularis, prominens, glaber. Capsulæ hucusque ignotæ.

This has much the look of *C. glabriflora*, Benth., a Murchison plant, in common with which it has glabrous flowers, so rare in the genus. The new species belongs, however, to the other section of the genus—*Wichurea*, characterized by a large annular free disc. It differs from its fellows of that section by reason of its subrotate corollas, its affinity appearing closest with *C. longistaminea*, F. Muell., but the spines, tomentum, and bracts are additional and weighty points of divergence.

## SAPINDACEÆ.

DODONÆA FILIFOLIA, *Hook.* Between Wilson's pool and Lake Darlôt, May.

D. LOBULATA, *F. Muell.* A shrub up to 5 feet at Bullabulling, September.

## LEGUMINOSÆ.

MIRBELIA MICROPHYLLOIDES, *S. Moore, in Journ. Bot.* XXXV. (1897) p. 164. A small subshrub about 3 feet high near Coolgardie. August. Flowers yellow and red.

OXYLOBIUM GRANITICUM, sp. nov. Fruticosa, elata, deinde fere glabra, foliis subverticillatis vel suboppositis rarius solitariis ovatis obtusissimis vel emarginatis brevipetiolatis tenuiter coriaceis conspicue et arcte reticulato-nervosis, racemis axillaribus terminalibusve elongatis laxifloris folia excedentibus, alabastris albido-sericeis, calyce pedicellum superante puberulo, floribus modicis aurantiacis, ovario longistipitato dense albido-sericeo, ovulis 6.

*Hab.* Viget apud petras graniticas ad Bullabulling, mens. Sept. florescens.

Frutex humanæ altitudinis vel paullo ultra, ascendens, crebro foliatus. Ramuli saltem sursum angulati, eximie striati, virescentes. Foliorum lamina 4·0–5·0 cm. long., 2·0–2·5 cm. lat., basi acuta apice brevissime apiculata, nervo mediano dorso maxime eminente, nervulis utrinque conspicuis; petioli 0·5 cm. long. Stipulæ lanceolatæ, circa 0·2 cm. long. Racemi 10·0–12·0 cm. long., deorsum nudi, sursum flores oppositos vel verticillatos raro solitarios circa 1·0 cm. long. ferentes. Bracteæ fugaceæ haud obviæ. Pedicelli 0·2–0·3 cm. long., juniores albo-pubescentes. Calycis lobi ciliati, superiores altius connati, ovati, obtusissimi, inferiores lanceolati, 0·3 cm. long., calyx totus 0·6 cm. long. Vexillum reniforme, vix 1·0 cm. lat. Filamenta 0·8 cm. long., deorsum dilatata ibique plus minus barbata. Ovarii stipes se ipsum æquans, sursum sericeus. Stylus compressus, apice leviter attenuatus. Legumen non vidi.

A very distinct and handsome species, which may be said to combine the foliage of *O. atropurpureum*, Turcz., and the inflorescence of *O. trilobatum*, Benth., or *O. parviflorum*, Benth.

PHYLLOTA LYCOPODIOIDES, sp. nov. Suffruticosa, stricta, sursum foliosa, sparsim ramosa, molliter villoso-tomentosa, foliis arcte imbricatis abbreviatis ægre omnino sessilibus oblongo-ovatis breviter apiculatis fere planis, stipulis 0, floribus modicis glomeratis glomerulis plurifloris terminalibus vel subapicalibus, bracteis bracteolisque lanceolatis acuminatis dense villosis, calycis villosi lobis tubum multo excedentibus axialibus quam abaxialia majoribus, vexillo calycem paullo excedente, staminibus inter se brevissime connatis et una cum petalis annulum angustum efformantibus, ovario brevissime stipitato dense villoso, stylo ovarium superante deorsum villoso.

*Hab.* Crescit inter Southern Cross et puteum "Wangine" sive "Siberia soak" dictum, mens. Jan. florens.

Circa $\frac{1}{3}$-metralis. Caulis deorsum nudus ibique novellas emittens, deinde glaber. Folia 0·5–0·6 cm. long., 0·3–0·4 cm. lat., supra minutissime tomentella, subtus villoso-tomentosa, costa media pag. inf. eminente et in apiculo brevi rigido decolore exiens. Glomeruli fere usque 3·0 cm. diam. Pedicelli circa 0·15 cm. long., crassi, villosi. Bracteolæ modice 0·7 cm. long. Flores brunnei. Calycis tubus circa 0·2 cm. long.; lobi axiales ovato-lanceolati, subito inæquilateraliter acuminati, 0·8 cm. long.; lobi abaxiales lanceolati, lobus medius quam laterales paullo brevior, hi longius acuminati et 0·65 cm. long., lobi omnes intus nitentes et saltem in sicco plus minus brunneo-aurantiaci. Vexillum circa 1·0 cm. long., 0·7 cm. lat., ejus unguiculus 0·35 cm. long.; alæ 0·8 cm. long; carina vexillo æquilonga, obtusa. Ovarii stipes circa 0·1 cm. long., ovarium ei oblique insertum, 0·35 cm. long., late oblongum, obtusum; stylus filiformis, sursum glaber, sub apice leviter dilatatus. 0·6 cm. long. De legumine inquirendum.

Mr. Bentham would doubtless have called this a *Pultenæa*, seeing that its affinity is undoubtedly with *P. Urodon*, Benth. Baron von Mueller, however, refers that plant to *Phyllota*, basing his view, apparently, upon the absence of stipules and the union of the stamens and petals into a short ring, which are characteristics of *Phyllota* and not of *Pultenæa*. Although usually agreeing with Bentham's views where they conflict with Mueller's, I am of opinion that the latter is right in this instance, and consequently propose to place the present plant in *Phyllota*. From *P. Urodon* it can easily be distinguished by its stouter habit, woolly tomentum, differently shaped leaves and calyx-lobes, as well as in a number of minor points.

PHYLLOTA HUMILIS, sp. nov. Suffruticosa, humilis, sparsim ramosa, foliis minutis imbricatis ovatis acutis sessilibus rigidis pubescentibus dein glabris, stipulis 0, floribus modicis axillaribus glomerulos paucifloros sessiles efformantibus, bracteolis anguste lanceolatis calyci applicatis, calycis villosi lobis tubum multo excedentibus axialibus quam abaxialia majoribus, vexillo calycem excedente, staminibus et petalis annulum ægre efformantibus, ovario sessili dense villoso, stylo ovarium superante deorsum piloso.

*Hab.* Inter puteum "Uladdie soak" dictum et Yilgangie repperi mens. Mart. florentem.

Suffrutex tantum 15·0 cm. alt. Rami tenues, paullo ultra 0·1 cm. diam., sparsim ramulosi, pauciflori, subteretes, patule pubescentes deinde puberuli. Folia 0·3 cm. long., 0·23 cm. lat., minutissime apiculata, concava, costa media dorso eminens. Glomeruli 3–4-flori, 1·0 cm. diam. Bracteolæ 0·3 cm. long., dorso villosulæ. Flores lutei. Calyx 0·5 cm. long.; lobi abaxiales ovato-lanceolati, laterales lanceolatos paullo excedentes, omnes breviter acuminati et eximie nervosi. Vexillum circa 0·8 cm. long., unguiculatum. Carina obtusa, vexillo fere æquilonga. Ovarium dense villosum, sessile, ovoideum, 0·3 cm. long. Stylus filiformis, sursum glaber, ibique gradatim attenuatus. Legumina desunt.

Allied to the last, and for the same reasons referred to *Phyllota*. There is nothing like it in that genus, nor am I acquainted with any species of *Pultenæa* with which it can be compared.

**Dillwynia** (§ Xeropetalum) **acerosa**, sp. nov. Suffrutex humilis ramosus, foliis abbreviatis anguste linearibus obtusis rigidis margine revolutis, floribus parvis axillaribus et solitariis vel in corymbis brevibus paucifloris dispositis, bracteolis minutis, calycis pubescentis lobis tubum subæquantibus abaxialibus usque medium connatis omnibus acutis, vexillo breviter unguiculato alas subæquante.

*Hab.* Prope Coolgardie floret mens. Aug.

Semimetralis vel minus. Ramuli rigidi, crebro ramosi, deorsum nudi. Folia 0·3–0·4 cm. long., 0·05 cm. lat., apice ipso leviter recurva, dorso rotundata nequaquam carinata, sursum canaliculata, appresse pubescentia demum glabra. Stipulæ 0. Pedunculi 0·1–0·2 cm. long., juxta apicem bracteolati. Bracteolæ lineares, obtusæ, 0·1 cm. long. Calyx totus vix 0·5 cm. long.; lobi 0·15 cm. long. Flores circa 0·5 cm. long. Vexillum expansum 0·6 cm. long. et lat., ungue excluso 0·4 cm. long., aurantiacum, purpureo-lineatum; alæ 0·7 cm. long; carina retusa, alis æquilonga, sursum purpurea. Legumen ignotum.

The affinity of this would appear to be with *D. brunioides*, Meissn., but the inflorescence is different, the leaves are not

keeled, the bracteoles are minute, the calyx pubescent, not villous, the vexillum not nearly twice as broad as long, the keel as long as the wings and retuse, not shorter than they and obtusely acuminate.

MEDICAGO DENTICULATA, *Willd.* Bullabulling, September. Undoubtedly introduced, most probably by teamsters.

LOTUS AUSTRALIS, *Andr.*, var. PARVIFLORA. Between Coolgardie and Gnarlbine, October. Gibraltar, September. Flowers pale purple.

PSORALEA ERIANTHA, *Benth.* Gibraltar, October.

INDIGOFERA BREVIDENS, *Benth.* Kilkenny soak, and Donkey rocks between Goongarrie and Mt. Margaret, June. A lowly subshrub with dark red flowers.

SWAINSONA CANESCENS, *F. Muell.* Between Coolgardie and Gnarlbine, October.

S. MICROPHYLLA, *A. Gray.* Near Coolgardie, August. Gnarlbine, September.

GLYCINE CLANDESTINA, *Wendl.*, var. SERICEA, *Benth.* This purple-flowered twiner was found near Kilkenny soak in June.

CASSIA PLEUROCARPA, *F. Muell.* Gibraltar, September. A handsome spreading shrub about 5 feet high; the flowers are yellowish-white with dark veins.

C. EREMOPHILA, *A. Cunn.* Between Doyle's well and Mt. George, June. A yellow-flowered shrub about 3 feet high.

C. ARTEMISIOIDES, *Gaudich.* Near Siberia soak, January. Coolgardie, August. A branching erect shrub, 3 to 4 feet high. Flowers yellow.—A variety of this with greatly reduced leaflets and flowers was found between Wilson's creek and Lake Darlôt, its yellow-green flowers appearing in May. It a subshrub about 2 feet high.

C. STURTII, *R. Br.* Between Doyle's well and Mount George, June. A subshrub 2½ feet high. Flowers yellow.

ACACIA ERINACEA, *Benth.* Near Coolgardie, August. A dense-growing lowly subshrub, a foot or so high.

**Acacia subcærulea**, *Lindl.* Near Coolgardie, August. Shrub up to 8 feet high.

**A. aneura**, *F. Muell.* Common between Wilson's pool and Lake Darlôt, where it is a shrub about 8 feet high, flowering in May. A variety with short phyllodes was met with at Pendinnie soak as a tall shrub bearing flowers in March.

**A.·(§ Julifloræ, Stenophyllæ) sibirica**, sp. nov. Fruticosa, elata, ramulis rigidis minute rufo-furfuraceis cito glabris, phyllodiis lineari-oblanceolatis apice obtusis apiculatis nequaquam pungentibus crassiusculis absque costa mediana utrinque in sicco sub lente obscure plurinerviis minute rufo-furfuraceis dein glabris, spicis brevipedunculatis abbreviatis ac revera quam phyllodia multo brevioribus, floribus 4- rarius 5-meris, calyce brevissime lobato, petalis usque ad medium coalitis, legmine?

*Hab.* Juxta puteum "Wangine" sive "Siberia soak" nuncupatum repperi mens. Jan.

Frutex diffusus, circa trimetralis. Ramuli subteretes, demum pruinosi, crebro foliati. Phyllodia 3·0–5·0 cm. long., 0·4–0·5 cm. lat., deorsum coarctata, petiolis 0·2 cm. long., in sicco rugatis suffulta, lutescenti-viridia. Spicæ circiter 1·0 cm. long., densifloræ; pedunculi 0·5–0·7 cm. long. Calycis lobi obtusissimi. Corolla calycem longe superans, 0·2 cm. long., ejus lobi oblongo-ovati, obtusi.

There is some doubt about the pods of this plant. My collecting-note says "pods short," and there are in the collection a couple of stray *Acacia*-pods which I think must be those of the present plant. These are apparently immature, the larger being oblong, about 1·5 cm. in length, half as much in breadth, and nearly flat. Attached to one of the specimens are two small, turgid, somewhat falcate apparent pods about 4 mm. long and almost as broad; but these look so different from the incipient pods of just-fertilized flowers, that I suspect the agency of an insect here. The nature of the pods of this species must, therefore, remain doubtful for the present.

The species is certainly closely allied to *A. aneura*, F. Muell., which, *inter alia*, has longer, narrowly linear phyllodes, mostly 5-merous flowers, and free narrow petals.

**A. brachystachya**, *Benth.* Between Coolgardie and Lake Darlôt. Precise locality not ascertainable, the label having been lost.

ACACIA ACUMINATA, *Benth.* Bullabulling, September. A beautiful tree, 20 feet high, with long broad cylindrical heads of flowers. This is the only species with such large heads seen upon the Goldfields.

What I conclude to be a variety of this, with much smaller and relatively broader phyllodes and extremely short flower-heads, is common between Wilson's pool and Lake Darlôt, as a shrub 8 to 10 feet high, flowering in June.

### CRASSULACEÆ.

TILLÆA VERTICILLARIS, *DC.* Bullabulling and Coolgardie, August and September.

### DROSERACEÆ.

DROSERA PELTATA, *Sm.* Bullabulling, September. Flowers white.

D. MACRANTHA, *Endl.* Nine-mile rocks near Coolgardie, August. This handsome sundew has white flowers. I also refer to the same species, though naturally with some doubt, a flowerless *Drosera* found upon the Donkey rocks, between Goongarrie and Mt. Margaret, in June.

D. MENZIESII, *R. Br.*, var. FLAVESCENS. Nine-mile rocks near Coolgardie; also, with somewhat smaller flowers, on Bullabulling rocks. It flowers in September.

### HALORAGEÆ.

LOUDONIA AUREA, *F. Muell.* Between Southern Cross and Siberia soak, January. A small form with greatly reduced flowers.

HALORAGIS GOSSEI, *F. Muell.* Near Coolgardie, August.

### MYRTACEÆ.

VERTICORDIA (§ CATOCALYPTA) HELMSII, sp. nov. Suffruticosa, ramosa, glabra, ramulis tenuibus, foliis parvis linearibus obtusissimis subteretibus, floribus pedunculatis, calycis tubo hemisphærico glabro ejus lobis primariis 5 alte divisis lobulis pectinato-ciliatis scariosis albis, lobis secondariis 0, petalis juxta calycis lobos insertis calyci æquilongis, tubo stamineo quam filamenti pars libera breviore, staminibus filiformibus, stylo glabro, ovulis circa 8.

*Hab.* Repperi juxta Gnarlbine mens. Nov. florentem. Habuit itaque cl. Helms ad Warangering, ex spec. in Herb. Kew. asserv.

Suffrutex ½-metralis. Ramuli tenues, obscure angulati, cinerei. Folia hac atque illac congesta, lutescenti-virentia, deorsum aliquantulum attenuata, 0·3–0·5 cm. long., 0·075 cm. lat. Bracteæ more generis cito evanidæ. Pedunculi 0·5 cm. long. Flores 0·7 cm. diam. Calycis tubus obscure 10-nervis, 0·15 cm. long.; lobi 0·35–0·4 cm. long., patuli, 7–9-pectinati. Petala ovata, acuta vel breviter acuminata, concava, 0·3 cm. long. Tubus stamineus circa 0·1 cm. long.; filamenta libera, lineari-subulata, 0·2 cm. long.; staminodia integra, filamentas liberas semiæquantia; antherarum parvarum ovoidearum loculi paralleli, longitudinaliter dehiscentes, connectivus haud incrassatus. Stylus elongatus, superne attenuatus, glaber.

To be compared with *V. picta*, Endl., from which, *inter alia*, it is to be distinguished on account of the very obtuse leaves, smaller flowers, petals not exceeding the calyx-lobes, more deeply divided staminal tube, smaller anthers, and glabrous style.

The plant gathered by Mr. Helms, of the Elder Expedition, agrees perfectly with mine. It is named "*Verticordia*," to which has been added "*aff. pictæ*," undoubtedly its affinity.

Calythrix desolata, sp. nov. Suffruticosa, erecta, crebro ramosa, ramulis tenuibus glabris, foliis parvis rectis imbricatis teretibus linearibus obtusissimis glabris, floribus purpureis ex axillis superioribus solitatim vel paucibus approximatis oriundis, bracteolis basi brevissime connatis longe acuminatis glabris, calycis tubo bracteas longe excedente amplo medio dilatato superne cavo, loborum aristis attenuatis petala excedentibus, staminibus indefinitis, stylo deorsum calyce incluso verisimiliter persistente.

*Hab.* Inter Wilson's creek et lac. Darlôt, mens. Maj. inventa.

Suffrutex parvus, semimetralis. Ramuli flexuosi, cinerei, summi reliquiis foliorum evanidorum more *Corallinæ* alicujus dense obsiti. Folia 0·2 cm. long., 0·05 cm. diam., dorso rotundata, conspicue glandulosa, petiolis brevibus triquetris fulta, in sicco flavescenti-virentia. Bracteæ obovatæ, subito acuminatæ, scariosæ, 0·5 cm. long. (acumine 0·1 cm. long. incluso). Calycis glabri tubus 0·8 cm. long., medio vix 0·1 cm. lat., sursum et deorsum leviter coarctatus, in longitudinem eximie nervosus; lobi ovati, vix 0·2 cm. long., arista 1·0 cm. long., superne gra-

datim attenuata coronati. Petala oblonga, ovata, acuminata, 0·65 cm. long. Connectivi glandula minuta, globosa. Stylus placentæ continuus, vix 1·0 cm. long., ejus dimidium inferius calycis tubo inclusum. De fructibus sileo.

A plant with much the look of *Calythrix brevifolia*, Meissn., and *C. brachyphylla*, Turcz., from which it can readily be distinguished by the terete, very obtuse leaves, the elongate-acuminate bracts, dilated calyx-tube, and differently inserted style. This latter character of stylar insertion brings it nearer to a series among which *C. Oldfieldii*, Benth., and *C. graveolens*, Benth., might possibly be mistaken for it. But the leaves of these are different, and among other points one may mention the bracts, which in the case of *C. Oldfieldii* are connate to the middle, of *C. graveolens* very obtuse.

THRYPTOMENE AUSTRALIS, *Endl.* Gnarlbine, November. A small white-flowered subshrub, 2 feet high.

T. URCEOLARIS, *F. Muell.* Between Gibraltar and Coolgardie, and near Gnarlbine, September. A small shrub with whity-pink flowers.

MICROMYRTUS IMBRICATA, *R. Br.* Between Wilson's creek and Lake Darlôt, May. Subshrub, a foot or so high. Flowers dirty white.

M. DRUMMONDII, *Benth.* A small shrub flowering in September between Gibraltar and Coolgardie.

WEHLIA THRYPTOMENOIDES, *F. Muell.* Between Gibraltar and Coolgardie, also at Gnarlbine, September. A small shrub with pink flowers.

BAECKIA CRASSIFOLIA, *Lindl.* Near Coolgardie, August.

KUNZEA SERICEA, *Turcz.* A small bush about 3 feet high, with scarlet flowers on the Bullabulling rocks (October), with white flowers (var. *albiflora*, nob.) at Gnarlbine (September). This was seen also as a tall spreading shrub, bearing buds and young fruits, but no expanded flowers, between Southern Cross and Siberia soak in January.

MELALEUCA UNCINATA, *R. Br.* A shrub, 4 feet or so high, near Gnarlbine, September.

MELALEUCA LEIOCARPA, *F. Muell.* Gibraltar district, September.

M. PAUPERIFLORA, *F. Muell.* Between Gnarlbine and Gibraltar. A tall shrub or small tree up to 20 feet, of obpyramidal habit. Flowers white, appearing in September.

EUCALYPTUS (§ ORTHANTHEREÆ) CAMPASPE, sp. nov. Frutex elatus ramosus, foliis brevipetiolatis lanceolatis obtuse acuminatis rectis vel parum falcatis, pedunculis axillaribus vel exaxillaribus abbreviatis late alatis 2–6-floris, pedicellis quam calycis tubus brevioribus, calycis tubo late turbinato, operculo subhemisphærico umbonato quam calycis tubus paullo longiore, antheris oblongo-ovatis loculis parallelis distinctis dehiscentibus, ovario quam calycis tubus parum breviore superne convexo.

*Hab.* Ad Gibraltar mens. Oct. florescit.

Circa tetrametralis. Folia 6·0–11·0 cm. long, juxta medium 1·0–2·0 cm. lat., basin versus sensim coarctata, utrinque pruinosa, costa media (præsertim subtus) eminens, costulæ inconspicuæ rete incompletum obscurum efformantes, costa marginalis margini approximata, nonnunquam obscura; petioli 1·0 cm. long. Pedunculi 0·6–0·8 cm. long., 0·3–0·4 cm. lat., una cum ramulis et pedicellis et calycibus albo-pruinosi. Pedicelli nec ultra 0·2 cm. long. Calycis tubus 0·4 cm. long., 0·6 cm. diam., conspicue marginatus. Operculum 0·6 cm. long., breviter et obtuse mucronatum. Stamina 1·0 cm. long., alabastro inflexa; antheræ 0·12 cm. long. Capsulæ desunt.

Although averse from describing as new specimens belonging to this large and difficult genus, yet those now under notice are so different from all known to me, that I cannot refrain from the venture. The affinity would seem to be with *E. rudis*, Endl., which is a tree with broader leaves on longer petioles; it has neither the short conspicuously winged peduncles nor the subsessile flowers; moreover, its operculum is longer and conical.

## FICOIDEÆ.

MESEMBRYANTHEMUM AUSTRALE, *Soland.* Yilgangie claypans, February. A lowly subshrub, a foot or so high. Flowers white. A small variety with much smaller flowers than those of type-specimens.

## UMBELLIFERÆ.

HYDROCOTYLE PILIFERA, *Turcz.*, var. GLABRATA. Gibraltar, October. An extraordinarily small form, fruiting in October.

TRACHYMENE CYANOPETALA, *Benth.* Gibraltar, September (flower and fruit).

T. ERIOCARPA, *Benth.* Gibraltar, September (fruit).

T. JUNCEA, sp. nov. Annua ?, parvula, fere omnino glabra, foliis sparsis parvis pinnatisectis vel ternatim-pinnatifidis lobis linearibus vel lanceolatis, involucri bracteis lanceolatis acutis pedicellos subæquantibus, fructibus mediocribus cordato-reniformibus glabris omnino inermibus vel tuberculis paucis minimis secus marginem dorsalem dispositis obscure armatis.

*Hab.* Ad Gibraltar florescebat et fructificabat mens. Sept.

Planta vix usque 7·0 cm. alt. Caulis ramulos plures strictos in sicco stramineos a basi emittens. Folia in toto usque ad 1·5 cm. long., pleraque vero breviora, deorsum nonnunquam sparsim albo-pilosula. Involucri bracteæ 5, circa 0·2 cm. long., cymbiformes, pilosulæ. Umbella circa 3–4-flora. Calycis lobi minutissimi. Stigmata capitellata. Pedicelli fructibus æquilongi. Fructus ad commissuram 0·2 cm. long., 0·3 cm. lat., carpella plerumque subæquimagna nisi æqualia, rubro-brunnea, parum turgida.

The lowly habit and the entirely unarmed or but feebly armed fruits are the marks by which this plant can be recognized.

## RUBIACEÆ.

CANTHIUM LATIFOLIUM, *F. Muell.* Between Wilson's creek and Lake Darlôt. May.

C. SUAVEOLENS, sp. nov. Fruticosa humilis inermis, foliis brevissime petiolatis linearibus obtusissimis marginibus arcte revolutis minute puberulis rigidis, cymis axillaribus paucifloris quam folia multo brevioribus, floribus mediocribus, corollæ lobis 5 quam tubus brevioribus, antheris vix exsertis, stigmate mitriformi integro.

*Hab.* Repperi juxta Mt. Margaret, ubi floribus albo-virescentibus suaveolentibus mens. Mart. gaudet.

Frutex ramosus, metralis, sursum foliatus. Rami teretes, primo puberuli cito glabri et cinerei. Folia 2·0–4·0 cm. long., 0·25–0·4 cm. lat., deorsum sensim ac leviter attenuata, vix nitentia, costa media utrinque obvia, costulæ inconspicuæ; petioli nec ultra 0·25 cm. long., breviter alati. Stipulæ parvæ, ovatæ, deciduæ. Cymæ circa 1·0 cm. long., vix totidem diam., modicæ,

4-floræ. Pedunculi circa 0·25 cm. long., minute puberuli. Pedicelli pedunculo æquilongi. Calyx breviter dentatus, 0·15 cm. long. Corolla tota 0·6 cm. long., usque ⅔ lobata, faucibus annulo pilorum auctis exclusis glabra; lobi lanceolati, obtuse acuti. Filamenta inclusa; antheræ brevissime exsertæ. Ovula lateraliter affixa. Stylus 0·6 cm. long., glaber. Stigma 0·1 cm. diam., deorsum cavum, in longitudinem sulcatum. Drupæ ignotæ.

The affinity of this is certainly with *Canthium oleifolium*, Hook., but the leaves of the two species are quite different, and among minor points it may be mentioned that the corollas of *C. suaveolens* are differently shaped, being relatively broader and the lobes decidedly longer than the tube. The habit also is different.

### COMPOSITÆ.

OLEARIA RAMULOSA, *Benth.* Near Siberia soak, January. A shrubby fragrant composite, about 3 feet high, of compact growth. Ray-florets white. A form considerably smaller than the type.

O. MUELLERI, *Benth.* Frequent at Gibraltar and Coolgardie. A handsome little subshrub flowering in August and September. The ray-florets are white. One form has longer ray-florets than ordinary.

VITTADINIA AUSTRALIS, *A. Rich.* Frequently seen: *e. g.*, Wilson's patch, between Mt. Margaret and Lake Darlôt, and elsewhere in the same district (May); near Coolgardie (August); Gibraltar (September). Florets purple or violet.

CALOTIS PLUMULIFERA, *F. Muell.* Near Coolgardie, August. Ray-florets white; disc yellow.

C. HISPIDULA, *F. Muell.* Bullabulling and near Coolgardie, August and September.

BRACHYCOME PACHYPTERA, *Turcz.* Gibraltar, September.

B. PUSILLA, *Steetz.* Between Wilson's creek and Lake Darlôt, May. Ray-florets pale purple.

B. CILIARIS, *Less.* Bullabulling, September.

B. CILIARIS, *Less.*, var. Near Coolgardie, August; Gibraltar, September.

B. COLLINA, *Less.* Near Coolgardie, August.

PLUCHEA DENTEX, *R. Br.* Creek near Wilson's pool, May.

PTERIGERON LIATROIDES, *Benth.*, var. REPENS, *nob.* Between Uladdie soak and Yilgangie claypans, March. Between Gibraltar and Coolgardie, October. A rather remarkable repent variety, exactly like the type except for its habit.

ELACHANTHUS OCCIDENTALIS, sp. nov. Pusilla, ascendens, piloso-pubescens vel puberula, caulibus filamentosis, foliis anguste linearibus obtusis sessilibus, capitulis parvis paucifloris, involucris demum anguste turbinatis, flosculis sterilibus circa 3, achæniis fertilibus anguste obovoideis dense lanatis, pappi setis circa 12 ovato-lanceolatis achænium subæquantibus.

*Hab.* Juxta Coolgardie floret et fructificat mens. Aug.

Usque ad 3·0 cm. alt., plerumque vero humilior, basi ramosa. Radix tenuissimus, parum flexuosus, raro ramulosus. Folia 0·5–0·7 cm. long., radicalia usque ad 1·0 cm., 0·03 cm. lat. Capitula 0·4 cm. long. et lat. Involucri squamæ exteriores 0·15–0·25 cm., interiores nec ultra 0·35 cm. long. Flosculi fœminei circa 8. Antheræ basi truncatæ. Achænia sub apice subito attenuata, 0·2 cm. long., compressiuscula. Pappi setæ brunneæ, paullo ultra 0·2 cm. long., acuminatæ, brevissime denticulatæ; flosculorum sterilium pappi setæ 2, flore ipso breviores, sursum longiuscule plumosæ.

This is a second species of a genus which, from the time of its foundation in 1852 until now, has remained monotypic. From *E. pusillus* it can be told at once on account of its different appearance, it being extremely small, with slender stems, and heads not nearly the size of those of *E. pusillus.* These small heads are fewer-flowered than is the case with the other species, for although Mr. Bentham says "female florets about 5–9," in the head I dissected there were no less than 14; and from cursory inspection one gathers that the heads of *E. occidentalis* are the fewer-flowered. The achenes of the new plant, although they appear to be not quite ripe, are manifestly the smaller, and are differently shaped, and have shoulders under the place of insertion of the pappus, the scales of which are differently shaped. The pappus-hairs of the sterile florets are, in the cases examined by me, two in number, whereas in *E. pusillus* they are about four; the latter, too, are longer both actually and relatively to their corollas, and they are not nearly so plumose.

ANGIANTHUS TOMENTOSUS, *Wendl.* Coolgardie and Gibraltar, September.

ANGIANTHUS PUSILLUS, *Benth.* Bullabulling, September. A common little everlasting, of which a very small variety, only 3·5 cm. high, was got at Gibraltar.

A. STRICTUS, *Benth.* Gibraltar, September.

GNEPHOSIS BURKITTII ?, *Benth.* Near Coolgardie, August. Differs from the type—a South-Australian plant—by reason of its longer stem (3–5 cm. high); its scattered leaves and somewhat larger flower-heads, and may possibly be a distinct and new species. I am unable to decide the point, however, as *G. Burkittii* is represented by a very small piece at Kew alone, so small, indeed, that I did not think it right to ask for leave to dissect the specimen.

G. INTONSUS, sp. nov. Herba humilis, ascendens, dense albo-lanata, foliis anguste linearibus vel lineari-oblanceolatis obtusis lanatis, capitulorum glomerulis sublaxe corymbiformibus, bracteis paucis foliis conformibus dense lanatis circumdatis, receptaculo parvo, capitulis partialibus 2–4-flosculatis, flosculis bractea comparate magna convoluta singillatim circumdatis, pappo 0.

*Hab.* Repperi ad Gibraltar mens. Sept.

Erecta, usque 5·0 cm. alt. Caulis tenuis, sparsim foliaceus. Folia 0·3–1·0 cm. long., superiora quam inferiora longiora ac latiora, omnia lanato-villosa. Glomeruli 1·0 cm. diam., dense lanato-villosi. Capitula partialia breviter pedunculata. Bractea circumdans ovata, acuminata, dorso dense lanata, vix 0·4 cm. long., rigida. Ovarium quam corolla paullo brevius, hæc linearis, 0·2 cm. long., fere omnino bractea occlusa. Achænia nondum obvia.

The woolly clothing and rigid acuminate woolly bract investing each flower are the marks by which this species can best be distinguished.

CEPHALIPTERUM DRUMMONDII, *A. Gray.* A common everlasting in the Coolgardie district in August. Involucres and florets white.

GNAPHALODES ULIGINOSUM, *A. Gray.* Bullabulling and near Coolgardie, August.

RUTIDOSIS HELICHRYSOIDES, *DC.* Between Southern Cross and Mt. Margaret. I am unable to more closely localize this find, the label having been mislaid.

MILLOTIA TENUIFOLIA, *Cass.* Gibraltar, September (fruit).

IXIOLÆNA TOMENTOSA, *F. Muell.* Between Coolgardie and Lake Darlôt (label lost).

ATHRYXIA TENELLA, *Benth.* Common near Coolgardie in August.

PODOTHECA ANGUSTIFOLIA, *Cass.* Near Coolgardie, August (flower). Gibraltar, September (fruit).

PODOLEPIS PALLIDA, *Turcz.* Abundant on the Bullabulling rocks, September. A lovely everlasting, with golden involucres and florets.

P. LESSONI, *Benth.* Near Coolgardie, August.

P. SIEMSENIA, *F. Muell.* Near Coolgardie, August.

SCHŒNIA CASSINIANA, *Steetz.* Near Coolgardie, August.

HELICHRYSUM FILIFOLIUM, *F. Muell.* Near Coolgardie, September. A lowly form, with heads smaller than those of the type, and the involucral bracts much less deeply tinged.

H. TEPPERI, *F. Muell.* Gibraltar, September. Hitherto recorded only from South Australia.

H. APICULATUM, *DC.* Between Southern Cross and Siberia soak, January.

H. (§ OXYLEPIS) PUTEALE, sp. nov. Suffruticosa, erecta, sparsim ramosa, ramis dense albo-lanatis fere usque ad capitula foliatis, foliis parvis sessilibus oblongis obtusis cauli applicatis supra viridibus subtus dense lanatis, capitulis parvis solitariis paucifloris, involucri ovoidei squamis numerosis linearibus sparsim lanatis interioribus lamina parva lineari-lanceolata coronatis, flosculis omnibus (?) hermaphroditis, achæniis glabris compressiusculis, pappi setis circa 15 minutissime barbellatis.

*Hab.* Prope puteum "Wangine" sive "Siberia soak" repperi mens. Jan.

Rami teretes, demum glabri et brunnei. Folia modica, 0·3–0·4 cm. long., circa 0·1 cm. lat., margine revoluta et undulata, supra fere glabra. Involucrum 0·4 cm. diam., ejus squamæ scariosæ, post anthesin maxime patentes, interiores vix 0·4 cm. long., extimæ multo breviores, omnes pallide stramineæ nervo mediano fusco percursæ; lamina circa 0·1 cm. long., concolor. Corollæ 0·4 cm. long. deorsum attenuatæ lobi lanceolati, obtusi. Achænia nondum matura, circa 0·13 cm. long., oblonga. Pappi setæ corollis æquilongæ, brevissime barbellatæ.

The section *Oxylepis* of *Helichrysun* is rather an unsatisfactory one, owing to the abnormal appearance given to the flower-heads by the narrow involucral bracts. Indeed, but for these organs being scarious and not herbaceous, the present plant would be a typical *Ixiolæna*. It also has much the appearance of a *Leptorhynchus*, from which the absence of any indication of a beak to the achenes must keep it apart.

HELICHRYSUM SEMIPAPPOSUM, *DC.* Gnarlbine, November.

H. (§ OZOTHAMNUS) CASSIOPE, sp. nov. Suffruticosa ?, erecta, sursum crebro ramulosa copiose foliosa, ramulis virgatis dense albo-lanatis, foliis minutis subteretibus anguste linearibus obtusis dorso canaliculatis scabridis cauli adpressis, capitulis parvis in paniculis subcorymbosis brevibus terminalibus paucicapitulatis dispositis, involucri turbinati squamis pluriseriatis arcte appressis absque lamina patente, achæniis glabris, pappi setis circa 20 brevissime barbellatis.

*Hab.* Ad Gibraltar floret mens. Oct.

Rami demum glabri et cinerei, usque ad capitula foliati. Folia vix 0·25 cm. long., approximata vix imbricata, puberula, rigida. Capitula 0·3 cm. long., basi saltem 0·03 cm., sursum 0·17 cm. lat. Involucri squamæ late obovatæ, obtusissimæ, circa 7-seriatæ, glabræ, scariosæ, pallide brunneæ et nitentes, intimæ fere 0·3 cm. long. Flosculi circa 12. Pappi setæ corollas paullo excedentes, 0·17 cm. long., albidæ. Achænia nondum matura circa 0·7 cm. long., anguste oblonga.

This should be placed next *H. diotophyllum*, F. Muell., of which it has much the general appearance; but the leaves, on examination, are seen to be quite different, and the smaller narrower capitula are much more laxly arranged. Among other details wherein the two species differ, one may mention the hirsute achenes of *H. diotophyllum*.

WAITZIA CORYMBOSA, *Wendl.* Common at Gibraltar and elsewhere in the Coolgardie district in August and September.

W. STEETZIANA, *Lehm.* Near Coolgardie, September.

HELIPTERUM MANGLESII, *F. Muell.* Nine-mile rocks near Coolgardie, August. Seen also on the rocks at Gnarlbine and

Bullabulling. Involucral bracts sometimes white, sometimes pink. Flourishes only in the soil from decomposed granite.

HELIPTERUM ROSEUM, *Benth.* Kilkenny soak, June. A variety of this beautiful everlasting with white involucres.

H. RUBELLUM, *Benth.* Common at Gibraltar and in the neighbourhood in August and September.

H. FITZGIBBONI, *F. Muell.* Rather common in September at Gibraltar, Bullabulling, &c.

H. FLORIBUNDUM, *DC.* Between Broad Arrow and Uladdie soak, March.

H. HETERANTHUM, *Turcz.* Near Coolgardie, August. A small form, only 6 cm. high.

H. HYALOSPERMUM, *F. Muell.* Near Coolgardie, August; also a larger-headed form at Bullabulling in September.

H. HAIGHII, *F. Muell.* Gibraltar, September.

H. STRICTUM, *Benth.* Gibraltar, September. A small form up to 22 cm. high, though usually less.

H. STRICTUM, *Benth.*, var. STENOCEPHALA, *nob.* Near Coolgardie, August. A lowly unbranched or but little branched variety, only 10–14 cm. high. Heads small and narrow.

H. OPPOSITIFOLIUM, *S. Moore, in Journ. Bot.* xxxv. (1897) p. 165. Near Coolgardie, September.

H. PYGMÆUM, *Benth.* Gibraltar, September.

H. PYGMÆUM, *Benth.*, var. OCCIDENTALE. Near Coolgardie, August.

H. ZACCHÆUS, *S. Moore, in Journ. Bot.* xxxv. (1897) p. 166.

H. (§ PTEROPOGON) VERECUNDUM, sp. nov. Pusilla, habitu *H. pygmæi*, Benth., ramulis tenuibus fere usque ad capitula foliatis una cum foliis præsertim sursum laxe albo-lanatis, foliis anguste linearibus obtusis, capitulis late ovoideis in corymbis laxis brevibus dispositis, involucri squamis ovatis concavis obtusis extimis reliquis similibus nisi minoribus interioribus lamina ovata obtusissima lutea ipsis æquilonga vel brevior, achæniis nondum maturis minutis glabris compressiusculis, pappi setis circa 6 eximie plumosis.

*Hab.* Juxta Coolgardie repperi mens. Aug. florentem.

Nec ultra 0·4 cm. alt., plerumque vero humilior. Folia radicalia pauca, caulinis similia; caulina modica, 0·5–0·8 cm. long., ascendentia. Involucrum 0·3 cm. long. et diam., puberulum; squamæ extimæ vix 0·2 cm. long., intimæ extimas duplo excedentes, omnes scariosæ et subnitidæ. Flosculi circa 12, minuti. Corollæ pappi setas paullo excedentes. Pappi setæ præsertim sursum dense plumosæ, 0·13 cm. long.

This has somewhat the appearance of a very much reduced state of *Helipterum hyalospermum*, F. Muell., which, as becomes a member of the section *Euhelipterum*, has hemispherical not ovoid flower-heads. The heads of the most reduced forms of *H. hyalospermum* are considerably larger and have more florets than those of *H. verecundum.* Moreover the involucral bracts are much larger, and their laminar appendages are longer and relatively narrower. There are also differences in the florets, achenes, and pappus.

*H. Zacchæus*, to which it is most closely allied, has oblong not ovoid capitula, narrower involucral scales (of which the inner have a narrow yellowish-green lamina), papillose achenes with 10 setæ to the pappus, &c.

HELIPTERUM POLYCEPHALUM, *Benth.* Gibraltar, September.

H. EXIGUUM, *F. Muell.* Near Coolgardie, August. An extremely small condition, only some 5 mm. high.

H. DIMORPHOLEPIS, *Benth.* Near Coolgardie, August; Gnarlbine, September.

GNAPHALIUM LUTEO-ALBUM, *Linn.* Creek N.W. of Wilson's pool, May. A dwarf state, barely 3 cm. high.

G. JAPONICUM, *Thunb.* Bullabulling, September. A small form not exceeding 10 cm. in height.

ERECHTHITES HISPIDULA, *DC.* Gibraltar, September.

SENECIO LAUTUS, *Forst.* Common in the neighbourhood of Coolgardie in August.

S. VULGARIS, *Linn.* Abundant in the Coolgardie district in springtime; probably introduced.

CRYPTOSTEMMA CALENDULACEA, *R. Br.* Near Coolgardie, August. Seen also in various places in the interior, where it is by no means infrequent.

SONCHUS OLERACEUS, *Linn.* Near Coolgardie, August.

### GOODENIACEÆ.

VELLEIA ROSEA, sp. nov. Humilis, pubescens, foliis radicalibus petiolatis anguste obovatis obtusissimis basi sensim attenuatis margine dentatis vel crenatis vel solummodo undulatis, scapo erecto folia vix duplo superante pubescente, bracteis ad furcas oppositis ovatis lobatis vel fere integris, sepalis 5 liberis sepalo axiali ovato-lanceolato ceteris lanceolatis omnibus subæquilongis acutis, corolla rosea extra pubescente ecalcarata hujus lobis omnibus utrinque alatis inferioribus 3 altius connatis, indusio medioeri.

*Hab.* Inter Wilson's pool et lac. Darlôt inveni mens. Apr. florentem.

Radix sat crassus, simplex. Novellæ lanatæ. Foliorum lamina 1·3–2·0 cm. long., circa 0·7 cm. lat., pubescens, basi in petiolum usque 0·7 cm. long. decurrens. Scapus paullo ultra 4·0 cm. alt., ad 3·0 cm. bracteatus. Bracteæ 0·6–0·8 cm. long., altera biloba, altera 1-dentata, ambo pubescentes. Floris unici maturi nobis obvii vix 1·5 cm. diam., pedicellus paullo ultra 1·0 cm. long. Sepala pubescentia, 0·65 cm. long., minora vix 0·2 cm. majus 0·35 cm. lat. Corollæ tubus dorso vix 0·25 cm. long., lobi inferiores 0·7 cm. long., superiores 1·0 cm. long., usque ad 0·45 cm. a tubo liberi, omnes late alati. Antheræ 0·1 cm. long. Ovula quove in loculo 4. Indusium ambitu rotundatum, 0·23 cm. long., pilosum. Capsulæ nondum obviæ.

Undoubtedly near *V. paradoxa*, R. Br., from which it differs chiefly in habit, small leaves, smaller rose-coloured flowers—very rare for the genus,—anthers not half the size, and quite different indusium.

The specimen, which is unique and has but one flower, was growing on the bank of a creek a short time after a heavy storm had visited the district. I could not find a fellow to it.

V. ? sp. A curious monster with somewhat the appearance of *V. connata*, F. Muell., but without its connate bracts. The runcinate radical leaves are situated on long petioles; the calyx-lobes are broadly ovate-lanceolate and prominently toothed along the borders. Corolla broad, not much exceeding the calyx.

Stamens none in all but one flower examined, which had a single one. Indusium large and cup-shaped.

Gibraltar district, September.

GOODENIA HEDERACEA, *Sm.* Gnarlbine, September.

G. MIMULOIDES, *S. Moore, in Journ. Bot.* xxxv. (1897) p. 167. Gibraltar, September.

SCÆVOLA SPINESCENS, *R. Br.* Common in various parts, as between Wilson's pool and Lake Darlôt (April), Coolgardie and Gibraltar district (September).

S. SPINESCENS, *R. Br.*, var. Between Coolgardie and Lake Darlôt. A form without spines and with rusty pubescent leaves and flowers, which, except for their small size, are very much like those of the type.

DAMPIERA LAVANDULACEA, *Lindl.* Gnarlbine and Bullabulling, September. Seen only in neighbourhood of soaks near granite rocks. Flowers sky-blue.

BRUNONIA AUSTRALIS, *Sm.* Gibraltar and Gnarlbine districts, September and October. May be as small as 4 cm.; my largest specimen is six times that size.

### LOBELIACEÆ.

ISOTOMA PETRÆA, *F. Muell.* Near Siberia soak, January. Gnarlbine, September.

### CAMPANULACEÆ.

WAHLENBERGIA GRACILIS, *A. DC.* Near Wilson's pool, May. Bullabulling and Gibraltar, September.

### PRIMULACEÆ.

ANAGALLIS ARVENSIS, *Linn.* Thoroughly established at Bullabulling rocks, September. Flowers blue.

### APOCYNEÆ.

ALYXIA BUXIFOLIA, *R. Br.* Common in the Coolgardie and neighbouring districts. A shrub up to 6 or 8 feet, with white flowers, which are produced from June till October. "Hop-bush."

### ASCLEPIADEÆ.

PENTATROPIS LINEARIS, *Decne.* Near Kilkenny soak, June. Flowers olive-green.

MARSDENIA LEICHHARDTIANA, *F. Muell.* Between Ninety-mile and Mt. Margaret, March. Near Kilkenny soak, June.

### BORAGINEÆ.

HALGANIA RIGIDA, sp. nov. Suffruticosa, erecta, viscida, ramis sat validis tomentellis vel pubescentibus tandem fere glabris, foliis brevipetiolatis linearibus apice obtusis interdum recurvis marginibus arcte revolutis crassiusculis rigidis subtus albo- vel rufo-tomentellis, cymis paucifloris quam folia brevioribus, floribus mediocribus, calycis lobis omnibus subæquilongis exterioribus ovatis interioribus ovato-lanceolatis, corollæ lobis ovatis vel oblongo-ovatis emarginatis, antheris abbreviatis apice brevissime appendiculatis intus pubescentibus.

*Hab.* Crescit juxta Coolgardie, mens. Aug. florens, necnon mens. Oct. ad Gibraltar.

Suffrutex metralis vel $\frac{2}{3}$-metralis, sursum ramosus. Ramuli crebro foliosi, subteretes, tomento minuto fulvo vel cinereo vestiti vel pubescentes nonnunquam puberuli. Folia 1·5–2·5 cm. long., 0·18–0·25 cm. lat., integra, pag. sup. puberula, erecta vel patentia, juniora vernicosa; petioli incrassati, 0·2 cm. long. Cymæ in toto usque ad 1·5 cm. long., vernicosæ. Bracteæ oblongæ, obtusæ, calyci applicatæ et eum subæquantes vel superantes, usque ad 0·6 cm. long. Pedicelli circa 0·25 cm. long., una cum bracteis et calycibus vernicosi. Calycis pubescentis, lobi vix 0·25 cm. long., exteriores 0·2 cm. lat., interiores circa 0·18 cm. Flores cyanei. Corollæ vix 1·0 cm. diam. lobi 0·4 cm. long., dorso obscure puberuli. Antheræ late oblongæ, 0·2 cm. long., appendice rotundata brevissima coronatæ. Fructus haud obvii.

Near *H. lavandulacea*, Endl., which has different leaves, larger flowers, linear inner calyx-lobes, longer and narrower corolla-lobes, and differently shaped anthers with (although short for the genus) longer spathulate appendages, the cells villous on the inside instead of pubescent.

H. VISCOSA, sp. nov. Suffruticosa, erecta, sursum ramosa, foliis parvis sessilibus anguste linearibus obtusis planis una cum

ramulis maxime viscosis, floribus parvis solitariis vel binis in cymis pauci- (2-3-) floris dispositis, pedunculis folia subæquantibus, calycis lobis inter se subæqualibus lanceolatis obtusis, corollæ lobis obovatis obtusissimis, antheris linearibus utrinque pubescentibus appendice ipsis æquilonga filamentosa coronatis.

*Hab.* Prope Gibraltar mens. Sept. florescit.

Suffrutex altitudinis innotatæ, forsan ⅓-metralis. Rami et ramuli teretes, demum in longitudinem rugati, hi tenues et erecto-patentes. Folia integra, rarissime sparsim dentata, 0·5–0·8 cm. long., vix 0·1 cm. lat., obscure strigoso-pubescentia, patenti-erecta. Pedunculi communes circa 0·3 cm. long.; pedicelli 0·2–0·5 cm. long. Calycis strigose puberuli lobis 0·15 cm. long. Flores circa 0·8 cm. diam., cyanei. Corollæ lobi 0·4 cm. long., 0·35 cm. lat., crenulati, glabri. Antheræ 0·25 cm. long., harum appendices pubescentes.

Undoubtedly near *Halgania strigosa*, Schlecht., but more viscid, and without so pronounced a strigose indumentum. The habit is slenderer, the leaves are much narrower, and the cymes less congested. The flowers are smaller, the corolla-tubes differently shaped, and the anther-appendages, nearly double the length of those of *H. strigosa*, run out into fine points, those of *H. strigosa* ending bluntly.

HALGANIA ? sp. Pendinnie soak, March. A small specimen without flowers as it comes to hand now, although marked on the ticket as having blue flowers.

ECHINOSPERMUM CONCAVUM, *F. Muell.* Near Coolgardie, August.

### CONVOLVULACEÆ.

CONVOLVULUS ERUBESCENS, *Sims.* The Brook, Mt. Margaret, February. Creek near Wilson's pool, May. Near Kilkenny soak, June. A rather common little twiner with pale pink flowers.

### SOLANACEÆ.

SOLANUM NUMMULARIUM, sp. nov. Suffruticosa, humilis, a basi ramosa, spinosa, tomento rufo arcte induta, spinis solummodo caulinis elongatis tenuibus late patentibus plerisque rectis, foliis minimis orbiculatis nonnunquam leviter retusis brevipetiolatis, floribus sat parvis binis pedunculo communi perbrevi oppositifolio suffultis raro solitariis, pedicellis folia excedentibus vel iis brevioribus, calycis lobis brevissimis latis obtusissimis, corollæ altæ lobatæ lobis ovato-lanceolatis extra tomentosis, antheris elongatis sursum gradatim attenuatis.

*Hab.* Crescit inter Gibraltar et Coolgardie, ubi mens. Sept. floret.

Suffrutex $\frac{1}{3}$-metralis, ascendens, crebro ramosus. Rami validi, teretes, dense rufo-tomentosi, copiose foliati. Spinæ pleræque oppositæ vel suboppositæ, circa 0·7 cm. long., basi ipsa amplificatæ, glabræ et nitidæ, integræ raro bifurcatæ. Folia modo 0·35–0·4 cm. long., 0·4–0·5 cm. lat., subtus pallidiora ibique densius tomentosa, crassiuscula; petioli 0·2 cm. long. Pedunculus communis circa 0·2 cm.; pedicelli 0·3–0·4 cm. long., una cum calyce 0·2 cm. long., dense rufo-tomentosi. Flores cyanei, 0·8 cm. diam. Corollæ tubus 0·25, lobi 0·65 cm. long. Antheræ lineari-lanceolatæ, vix 0·6 cm. long. Bacca hucusque non reperta.

A very elegant little *Solanum*, evidently allied to *S. orbiculatum*, Dun., which, however, with the same habit, has much larger leaves, a white not rusty tomentum, larger flowers with relatively broader corolla-lobes, and narrower and more pointed anthers. It is not uncommon in the district from which it is reported.

SOLANUM CHENOPODINUM, *F. Muell.* Near Coolgardie, August. A subshrub, 2 feet high. Bushy habit.

S. LASIOPHYLLUM, *Dun.* Between Wilson's pool and Lake Darlôt, May. Seen elsewhere in the neighbourhood of gnamma rocks, growing in decomposed granitic soil.

S. ELLIPTICUM, *R. Br.* Near Coolgardie, August.

LYCIUM AUSTRALE, *F. Muell.* Plain south of Doyle's well, June. A small, densely-branched shrub, 3 feet high. Flowers pale lavender, tetramerous.

NICOTIANA SUAVEOLENS, *Lehm.*, var. ROSULATA, *nob.* Bank of creek near Wilson's pool. An extraordinarily small form of this so widely diffused Australian tobacco. Stem 3·5–12·0 cm. high. Leaves rosulate, 1·0–3·0 cm. long. Corollas 2·0 cm. in length. Flowers white.

## MYOPORINEÆ.

PHOLIDIA SCOPARIA, *R. Br.* Between Southern Cross and Mount Margaret; also at Gibraltar, flowering in September. A very common shrub, seen elsewhere in various places.

PHOLIDIA SALIGNA, sp. nov. Fruticosa, glandulosa, erecta, sursum foliosa, foliis subsessilibus lineari-lanceolatis mucronato-acuminatis deorsum integris sursum plus minus serrulatis infime in petiolum longe et sensim angustatis, floribus mediocribus axillaribus solitariis vel 2–3-nis, pedunculis quam folia brevioribus, calycis parvi lobis levissime imbricatis lanceolatis acutis, corolla calycem multo excedente a basi sat lata usque ad medium sensim ampliata hinc admodum attenuata, lobis abbreviatis superioribus minoribus et altius connatis lobo infimo lateralibus distincte majori, ovulis collateralibus.

*Hab.* Juxta Gnarlbine repperi crescentem mens. Sept.

Frutex elatus, humanem altitudinem attingens, deorsum nudus. Rami erecti, sat tenues, angulati, lineis glandulosis muniti, cinerei, juniores copiose resinosi. Folia modica, circa 3·0 cm. long., 0·3–0·4 cm. lat., apice pungentia, coriacea, læte viridia, sub lente minute furfuracea, costa media pag. sup. impressa, pag. inf. eminens; petioli circa 0·5 cm. long. Pedunculi usque ad 1·0 cm. long., plerique vero breviores, sursum incrassati. Flores albi. Calyx 0·2 cm. long., glaber. Corollæ in toto 0·8 cm. long. basi 0·15 cm. medio 0·45 cm. lat. tubus intus dorso barbatus, lobi superiores ovati, obtusi, lobus infimus late ovatus, retusus, intus puberulus, stamina inclusa, didynama. Ovarium glabrum, calyci æquilongum. Stylus glaber, ovarium 2½plo superans, apice uncinato-incurvus. Fructus non vidi.

A rather noteworthy plant, having much the general appearance of *Myoporum platycarpum*, R. Br.; in fact it is remarkably homoplastic with forms of that species of which the leaves are serrulate, although it can be told at once by the curious lines of glands running down the stem from the points of insertion of the leaves. Of course the flowers are quite different in the two cases. Moreover, the inflorescence of *Ph. saligna* is peculiar.

PH. HOMOPLASTICA, sp. nov. Fruticosa, copiose ramosa, ramulis tenuibus glabris, foliis minimis oblongis obtusis cauli arcte applicatis vix imbricatis dorso tuberculosis glabris, floribus mediocribus axillaribus brevipedunculatis, calycis lobis (una cum pedunculis) laxe tomentosis oblongo-ovatis obtusis imbricatis, corollæ calycem vix triplo excedentis tubo a basi sat lata sensim ampliato lobis ovatis obtusissimis (lobo infimo revera late obovato retuso), superioribus altius connatis, staminibus inclusis, ovulis collateralibus.

*Hab.* Viget loco haud accuratius indicato inter Coolgardie et Mt. Margaret, ubi mens. Mart. florescebat.

Frutex altitudinis innotatæ. Rami sat validi, pennæ corvinæ crass., dense suberei; ramuli circa 0·06 cm. diam., juniores foliis fere in toto absconditi. Folia modica, 0·2 cm. long., 0·075 cm. lat., dorso plus minus canaliculata, glaucescentia deinde aurantiaca. Pedunculi 0·2 cm. long. Calycis lobi subæquales, vix 0·25 cm. long. Corolla tota 0·7 cm. long., basi 0·12, sursum 0·25 cm. lat., extra et intus pubescens, lobi superiores usque ad 0·1 cm. long., inter se liberi; lobi laterales 0·16 cm. long., lobus infimus lateralibus paullo longior. Stamina didynama, prope basin tubi inserta. Ovarium glabrum, 0·16 cm. long. Stylus ovarium duplo superans, glaber, apice uncinato-incurvus. Capsula?

The habit of this plant is almost exactly that of *Pholidia gibbifolia*, F. Muell. (*Eremophila gibbosifolia*, F. Muell.), and it would be difficult even for a botanist to tell the two apart until they flower: then the difference is manifest, for the calyx of *Ph. gibbifolia* is glabrous and its lobes are almost setaceous; its corolla, glabrous outside, has a sudden basal constriction, and its lobes are differently shaped, the lower lip's mid-lobe being much larger relatively to the rest, and acute instead of retuse; its anthers, too, are much smaller and are set on longer filaments which arise considerably higher up in the tube. I cannot but consider this to be one of the most remarkable cases of vegetable homoplasy on record.

By some mischance the collecting-note has got separated from the specimens, so that I cannot localize the habitat of this plant. I have an idea that it was found somewhere near, if not at, Pendinnie soak.

PHOLIDIA CÆRULEA, sp. nov. Suffruticosa, erecta, ericoidea, sursum copiose foliata, foliis sat magnis sessilibus approximatis alternis anguste linearibus obtusis subteretibus leviter glanduloso-tuberculosis cito omnino glabris, floribus sessilibus ex axillis foliorum summorum aliquorum oriundis, calycis lobis parum imbricatis linearibus vel lineari-lanceolatis ciliatis, corollæ tubi parte attenuata calycem paullo excedente sursum subito amplificata, lobis superioribus altius connatis lobo medio reliquis majore intus barbato, antheris inclusis vel brevissime exsertis, ovulis collateralibus.

*Hab.* Ad Gibraltar floret mens. Oct. Ejusdem invenit specimina cl. Helms ad Warangering.

Circa ⅔-metralis; partes juniores pubescentes mox glabræ. Rami validi, cinerei, reliquiis foliorum evanidorum crebro induti. Folia 0·6–1·0 cm. long., 0·13 cm. lat., ascendentia vel patentia, nec imbricata. Calyx vix 0·5 cm. long., pubescens. Corolla cærulea, in toto 1·0 cm. paullo excedens, cujus pars coarctata 0·5 cm. long. attinet; lobi ovati, obtusissimi, superiores 0·15 cm. long., 0·25 cm. lat., lobus infimus vix 0·4 cm. lat. Stamina didynama, superiora corollæ lobis æquialta. Ovarium vix 0·2 cm. long., villosum. Stylus 1·0 cm. long., basi ipsa barbatus. De fructu inquirendum.

To be compared with *Pholidia microtheca*, F. Muell., and *Ph. densifolia*, F. Muell. From the former its larger, thicker, more closely placed tuberculous leaves, larger flowers, hairy smooth ovary, and style hairy at the base may be cited among other distinctions. *Ph. densifolia* has quite different leaves, narrower calyx-lobes, corolla narrowed below for only a very small distance, and its lobes acute.

The Elder Expedition plant, of which I have seen a specimen at Kew, agrees exactly with mine.

Pholidia Veronica, sp. nov. Suffruticosa, stricta, ericoidea, glabra, sursum foliosa, foliis minimis imbricatis pentastichis semiteretibus anguste linearibus acutis, floribus parvis sessilibus in axillis summis sitis, calycis lobis linearibus acutis leviter imbricatis, corollæ a basi gradatim ampliatæ lobis superioribus altius connatis lobo infimo laterales vix excedente intus pubescente, antheris breviter exsertis nec lobos excedentibus, ovulis collateralibus.

*Hab.* Repperi haud raram ad Gibraltar, ubi mens. Sept. flores profert.

Suffrutex usque metralis. Rami deorsum nudi, validi, teretes, foliorum lapsorum reliquiis muniti, tandem conspicue rimati. Folia 0·3–0·5 cm. long., 0·07 cm. lat., supra plana vel leviter concava, subtus carinata, erecta deinde ascendentia vel patentia. Flores cærulei. Calyx vix 0·4 cm. long.; lobis deorsum ciliatis. Corollæ tubus 0·55 cm. long., nequaquam subito attenuatus, latere inferiore pubescens; lobi late ovato-oblongi, obtusissimi, superiores 0·2, inferiores 0·35 cm. long.; stamina didynama. Ovarium

glabrum, 0·13 cm. long. Stylus ovarium quater excedens, glaber. Fructus desunt.

This has the habit of *Eremophila exilifolia*, F. Muell., which is a true *Eremophila*, with flowers on long pedicels and foliaceous calyx-lobes. The affinity of *Pholidia Veronica* is doubtless closest with the species last described (*Ph. cærulea*), from which it is at once distinguished by its different leaves, small flowers, narrower calyx-lobes, corolla not suddenly narrowed below, middle of lower lip subequal to its lateral fellows, and glabrous ovary and style.

PHOLIDIA INTERSTANS, sp. nov. Arborea, sursum copiose ramosa, ramulis attenuatis una cum foliis minute argenteo-furfuraceis, foliis alternis anguste linearibus apice breviter recurvo-uncinatis supra canaliculatis crassiusculis, floribus mediocribus axillaribus solitariis raro binis, pedunculis brevibus, calycis lobis oblanceolatis obtuse acutis subscariosis ciliatis, corolla tubularis a basi lata levissime amplificata ejus lobis æqualibus vel paullo inæqualibus superioribus parum altius connatis, staminibus inclusis vix didynamis, ovulis collateralibus vel superpositis.

*Hab.* Inter Coolgardie et Gnarlbine floret mens. Aug.

Arbor gracilis, stricta, circa 6-metralis, cortice crasso corrugato cincta. Ramuli virgati, angulati, in sicco olivacei. Folia 1·0–1·5 cm. long., ascendentes, sub apice subito recurva ibique decolora. Pedunculi 0·2–0·3 cm. long. Flores albi. Calyx totus 0·35–0·4 cm. long.; lobi obscure reticulato-nervosi, post anthesin levissime ampliati. Corolla tota vix 1·0 cm. long., extra et intus pubescens, ejus lobi 0·22–0·25 cm. long. Filamenta brevia, subæquilonga, juxta basin corollæ inserta. Ovarium oblongo-ovoideum, pubescens, 0·17 cm. long.; stylus glaber, ovarium 2½plo superans. Ovula in loculis nunc collateralia nunc superpositus. Fructa ignotus. Hujus legi varietatem insequentem:

Var. PARVIFLORA. Folia quam ea typi breviora; flores miniati, modo 0·6 cm. long.; ovarium brevius et ovoideum; stylus pinguior, pubescens; ovula collateralia.

Frutex 2½-metralis juxta Gnarlbine mens. Oct. florebat.

A plant intermediate in character between *Pholidia* and *Eremophila*, hence its name. Except for the leaves being alternate, the habit, that is as seen in herbarium specimens, is much that of *Ph. scoparia*, R. Br., or better of *Ph. Dalyana*, F. Muell. While the calyx is decidedly that of *Eremophila*, the corolla and stamens are as clearly those of *Pholidia*; but the placentation is sometimes that of the one, and sometimes that of the other genus. In dissecting the type-form I have several times found in one cell of the ovary a couple of superposed ovules, while the other cell has had but one; in other cases there are two superposed ovules in each of the cells.

Those who share the late Baron Mueller's views, as explained in his splendid monograph of the Australian Myoporineæ, will point to this case as supporting the contention that the species of *Pholidia* and *Eremophila* ought properly to be ranged under one genus. On the whole, however, I prefer, with Bentham, to keep the genera distinct, the *Pholidias* being easily recognized by their habit, small flowers with only the beginnings of zygomorphy, and collateral ovules.

EREMOPHILA LEUCOPHYLLA, *Benth.* Creek between Wilson's pool and Lake Darlôt, April. Near Kilkenny soak, June. A small shrub, up to 3–4 feet. Flowers pale- or brown-pink.

E. (§ ERIOCALYX) MARGARETHÆ, sp. nov. Suffruticosa, sursum foliosa, foliis lineari-lanceolatis obtusis vel acutis deorsum sensim in petiolum brevissimum attenuatis arcte et minute stellato-tomentosis demum furfuraceis, floribus solitariis pedunculis brevibus a foliis multo superatis lanatis fultis, calycis extra et intus stellato-tomentosi lobis lineari-lanceolatis haud imbricatis, corollæ tubo extus puberulo a basi leviter ac sensim amplificato calycem duplo superante, labio superiore usque ad medium bilobo lobo infimo lateralibus subæquali lobis omnibus obtusis, staminibus inclusis, ovario ovoideo-oblongo glabro, ovulis per paria superpositis.

*Hab.* Repperi prope Mt. Margaret mens. Mart., necnon mens. Jun. propre puteum "Doyle's well" dictum.

Suffrutex usque $\frac{2}{3}$-metralis. Ramuli glanduloso-tuberculati, dense ac minute tomentosi, deinde glabri et cortice crasso cinereo obducti. Folia 2·0–3·0 cm. long., 0·2–vix 0·3 cm. lat., firma, in sicco pallida, erecta. Pedunculi 0·4 cm. long. Flores cærulei vel lavandulacei. Calycis lobi 0·8 cm. long., obtusi. Corollæ tubus vix 1·2 cm. long., 0·5 cm. lat., intus faucibus pubescentibus exemptis glaber; lobi extra stellatim pubescentes, superiores 0·5 cm., inferiores 0·6 cm. long. Stamina juxta basin tubi inserta. Ovarium vix 0·3 cm. long., a stylo puberulo $2\frac{1}{2}$plo superatum. Fructus?

So far as concerns the general appearance and especially the foliage of this plant, it is much like *Eremophila Maitlandi*, F. Muell. Of this latter I have not seen flowers, but a glance at the plate devoted to it in Baron Mueller's monograph shows that there can be no mistaking the two; for *E. Maitlandi* has much larger flowers on long pedicels, the calyx-lobes and corolla upper-lip are quite different, the ovary ends acutely, and the style, provided at its base with a pilose ring, is remarkably dilated upwards.

Eremophila (§ Eriocalyx) punicea, sp. nov. Fruticosa vel suffruticosa, ramosa, sursum crebro foliata, ramulis dense fulvo-tomentosis deinde glabris, foliis abbreviatis oblanceolato-oblongis obtusis deorsum in petiolum brevissimum sensim coarctatis utrinque dense fulvo- vel albo-stellato-tomentosis, floribus solitariis pedicellis foliis brevioribus suffultis, calycis stellato-tomentosi lobis late linearibus obtusissimis, corollæ tubo puberulo paullo supra basin coarctato hinc dilatato lobis superioribus usque ad medium inter se liberis lateralibus infimo subæqualibus infimo obtuso reliquis acutis, staminibus exsertis, ovario glabro a stylo glabro multoties superato, ovulis per paria superpositis.

*Hab.* Ad puteum "Pendinnie soak" nuncapatum repperi mens. Mart. florentem.

Ramuli rigidi, reliquiis fol. evanidorum obsiti, deinde crasse corticati. Folia modica, 0·8 cm. long., 0·2–0·3 cm. lat., erecto-imbricata, marginibus parum revolutis. Pedunculi 0·3 cm. long., dense tomentosi. Flores punicei. Calycis lobi 1·0 cm. long., utrinque stellato-tomentosi. Corollæ tubus vix 1·7 cm. long., ima basi 0·25 cm. lat., paullo supra basin ad 0·18 cm. angustatus, sub limbo 0·7 cm. lat.; lobi omnes ovato-oblongi, infimo paullo latiore et breviore, lobi superiores usque 0·35 cm. liberis, lateralibus 0·8 cm. long. Filamenta juxta basin tubi inserta, puberula, 2·5 cm. long. Ovarium oblongo-ovoideum, vix 0·3 cm. long.; stylus 2·0 cm. attingens. Fructus?

Allied to *E. Mackinleyi*, F. Muell., from which it can easily be distinguished by its different leaves, the much broader and very obtuse, not so lengthily tomentose calyx-lobes, the exserted stamens, the puberulous not tomentose corolla, and the glabrous ovary and style. It also bears some superficial resemblance to small-leaved forms of *E. Latrobei*, F. Muell., which, however, is a member of another section. From *Eremophila Margarethæ*, to which it is closest allied, it can be told by means of the leaves, the larger corollas with the tube narrowed a short distance above the base and then expanded again, exserted stamens, and greatly elongated style.

EREMOPHILA OPPOSITIFOLIA, *R. Br.*, var. ANGUSTIFOLIA, *nob.* Between Doyle's well and Mt. George, June. Gibraltar, October. A shrub 4–5 feet high. Flowers milk-white or pinkish-white. The leaves are narrowly linear, usually not exceeding a millimetre in width.

E. PAISLEYI, *F. Muell.* Gnarlbine, November. A shrub 5 feet high. Flowers dirty white.

E. (§ EREMOCOSMOS) METALLICORUM, sp. nov. Suffruticosa, copiose ramosa, sursum foliata, ramis patulis rigidis, foliis parvis sessilibus lineari-oblanceolatis obtusis minute furfuraceo-pubescentibus junioribus viscidis, pedunculis solitariis tenuibus folia bene excedentibus, calycis pubescentis lobis amplis basi imbricatis ovatis vel oblongis obtusis membranaceis, corollæ extra tomentosæ lobis superioribus altius connatis lobo infimo lateralibus ampliore, ovarium villosum, stylo puberulo, ovulis quove in loculo tribus uniseriatim insertis.

*Hab.* Inter Wilson's pool et lac. Darlôt florebat mens. April.

Suffrutex submetralis. Ramuli furfuraceo-pubescentes mox glabri. Folia modica 0·7 cm. long., 0·1–0·2 cm. lat., ascendentia vel patentia nec imbricata. Pedunculi 1·0–1·3 cm. long., gracillimi, piloso-puberuli, patentes vel nutantes. Flores cyanei. Calycis lobus superior ovatus, tandem (sc. sub fructu) 0·5 cm. long., reliqui angustiores et vix 0·8 cm. long., omnes sub fructu eximie reticulato-nervosi et nitiduli. Corollam maturam non vidi. Fructus (an maturus?) ovoideus, obtusus, a lateribus compressus, in longitudinem rugatus, piloso-villosus, 0·6 cm. long., 0·5 cm. lat., stylo 0·8 cm. long. coronatus.

My collecting-note says that the flowers are blue, but by some means they have been mislaid, and only one small bud is available for examination. Nevertheless the plant seems so distinct that I do not hesitate to describe it. Its affinity is doubtless with *E. exilifolia*, F. Muell., but the leaves are quite different and not imbricated, the calyx is not quite the same, and the ovary and fruit are not glabrous and acuminate.

EREMOPHILA LATROBEI, *F. Muell.* Plain south of Doyle's well, also near Kilkenny soak, June. Shrub or subshrub, 2–5 feet high. Flowers crimson.

E. LATROBEI, *F. Muell.*, var. TUBERCULOSA, *nob.* Leaves linear, only 1·0–1·5 mm. wide, with a row of prominent glandular tubercles on each side of the midrib. Between Wilson's pool and Lake Darlôt, May. A small shrub about 3 feet high. Flowers red.

E. LONGIFOLIA, *F. Muell.* Between Broad Arrow and Uladdie soak, March. Shrub about a man's height. Flowers pinkish-brown.

E. DRUMMONDII, *F. Muell.* Gibraltar, September.

E. (§ PLATYCHILUS) GRANITICA, sp. nov. Fruticosa, viscosa, foliis alternis rarius oppositis vel subopposititis anguste linearibus obtusis supra excavatis, floribus solitariis longe ac graciliter pedunculatis, calycis lobis imbricatis amplis ovatis acutis utrinque plus minus pubescentibus puberulisve post anthesin auctis, corolla calycem bene excedente extra et intus pubescente ejus tubo a basi amplo leviter et sensim amplificato lobis superioribus alte connatis lobo infimo quam lateralibus majore, filamentis inclusis puberulis, ovario dense sericeo-villoso stylo piloso coronato, ovulis per paria superpositis.

*Hab.* Crescit apud petras graniticas "Nine-mile rocks" dictas, ditione Coolgardiensi, mens. Aug. florescens.

Fruticosa, erecta, diffusa, humanæ altitudinis. Ramuli subteretes, glabri deinde cinerei, in longitudinem rimosi, ultimi attenuati. Folia (una cum ramulis) viscosa, sessilia, patentia, 1·5–2·0 cm. long., raro 2·5 cm. attingentia, 0·075 cm. lat., in sicco olivacea vel olivaceo-atrata. Pedunculi usque ad 2·0 cm. long., compressi, sub flore aliquanto incrassati. Flores pallide punicei. Calycis lobi ovato- vel oblongo-lanceolati, longiores 1·2 cm., breviores 0·8 cm. long., omnes membranacei et post anthesin reticulato-nervosi. Corolla tota usque ad 2·5 cm. long.; tubus ad medium 0·8 cm. lat., labium superius 1·0 cm. excedens, usque ad 0·25 cm., bilobum; lobi laterales oblongi, obtusi, lobo infimo obovato æquilongi. Stamina didynama, filamenta 1·0 cm. long., haud procul a basi tubi inserta. Ovarium anguste oblongum, 0·3 cm. long.; stylus 1–3 cm. attingens. Fructus non vidi.

Near *Eremophila platycalyx*, F. Muell., which is not viscous and has different foliage, and also shows marked inequality in its broader calyx-lobes, of which some are almost orbicular. It also has a glabrous and relatively longer corolla-tube and a glabrous or slightly glandular-tomentose instead of densely villous ovary. *E. Freelingii*, F. Muell., has, *inter alia*, entirely different leaves, marked inequality in its calyx-lobes, and mid-lobe of corolla nearly equal to the lateral ones.

EREMOPHILA FRASERI, *F. Muell.* Near Lake Darlôt, April. A spreading resinous shrub, up to 8 feet high, though usually shorter. Flowers dirty white with maroon spots; accrescent calyx red. The form gathered by me is that with narrower calyx-lobes.

E. BROWNII, *F. Muell.* Yilgangie claypans, February. A shrub about 4 feet high, with red flowers.

E. BROWNII, *F. Muell.*, var. Leaves narrowly linear lanceolate. Flowers considerably smaller than those of type. Gibraltar, October.

E. OLDFIELDII, *F. Muell.*, var. ANGUSTIFOLIA, *nob.* Between Doyle's well and Mt. George, June. A shrub up to 5 feet or so. Leaves narrowly linear, 1 mm. wide.

E. MACULATA, *F. Muell.* Near Coolgardie, August. Between Coolgardie and Gnarlbine, September.

E. MACULATA, *F. Muell.*, var. BREVIFOLIA. Between Coolgardie and Broad Arrow, and between the latter place and Uladdie soak, March. Copiously branching subshrub, a foot or so high. Flowers pink or nearly white.

E. LATIFOLIA, *F. Muell.* Between Wilson's pool and Lake Darlôt, May. Small shrub, 3 feet or so high. Flowers green.

E. ALTERNIFOLIA, *R. Br.* Gibraltar district, October. Flowers red.

E. YOUNGII, *F. Muell.* Between Doyle's well and Mt. George; also Goose's soak, June. A spreading bush up to 6 or 8 feet. Flowers pale pink.

## VERBENACEÆ.

SPARTOTHAMNUS TEUCRIIFLORUS, *F. Muell.* (ex descript.). Pendinnie soak, March. Between Mt. Malcolm and Goose's soak, June. A plant not infrequently met with in the back country as a subshrub up to 3 feet high. The flowers are white and sweet-scented: the berries black.

### LABIATÆ.

PROSTANTHERA BAXTERI, *A. Cunn.* Between Southern Cross and Siberia soak; also between Ninety-mile lake and Mt. Margaret, January, and Gnarlbine, September. Subshrub or shrub 2–3 feet high, plentifully branched. Flowers pale lavender or white streaked with purple.

P. WILKIEANA?, *F. Muell.* Between Uladdie soak and Yilgangie claypans, March. Creek between Wilson's pool and Lake Darlôt, April. Small shrub, 3 feet or so high. Flowers dirty white. Accrescent calyx lemon-coloured.

I have not seen the type of this species, but Baron von Mueller's description (Fragm. viii. p. 230) agrees fairly well with my specimens.

P. GRYLLOANA, *F. Muell.* (ex descript.). Siberia soak, January. Coolgardie district, September. Small shrub about 3 feet high. Flowers dull red.

The specimens answer well to Baron von Mueller's description.

HEMIGENIA (§ EUHEMIGENIA) EXILIS, sp. nov. Suffruticosa sursum foliigera, foliis lineari-lanceolatis obtusis vel minute mucronulatis basi sensim angustatis subcoriaceis glabris, floribus solitariis vel in verticillastris 3–4-floris dispositis, pedunculis quam folia brevioribus juxta medium bracteolatis, calyce quam pedunculus breviore minute puberulo, corollæ minute pubescentis tubo calycem fere triplo excedente, labio superiore bilobo labii inferioris lobo intermedio haud lobato, antherarum omnium connectivo inferne æqualiter vel subæqualiter producto lineari raro clavato glabro.

*Hab.* Crescit inter Wilson's pool et lac. Darlôt, mens. Apr. floribus gaudens.

Suffrutex altus fere metralis. Ramuli tetragoni, dein subteretes et cortice cinereo in longitudinem rimoso obducti. Folia sessilia, 1·0–1·5 cm. long., circa 0·2 cm. lat., fere enervia, in sicco læte viridia. Pedunculi 0·3–0·6 cm. long., glabri. Bracteolæ subulatæ, circa 0·1 cm. long. Flores purpurei. Calycis 0·3 cm. long. 0·2 cm. lat. lobi subæquales, lanceolato-subulati, a tubo 2plo superati. Corollæ tubus attenuatus, 0·8 cm. long.; limbus circa 0·5 cm. diam.; labii superioris lobi late ovati, usque ad 0·15 cm. liberi; labii inferioris lobi laterales ovato-oblongi, 0·33 cm. long., lobus intermedius oblongo-obovatus, 0·4 cm. long., erosulus. Stamina breviter exserta; antherarum connectivus usque ad 0·1 cm. productus, interdum multo brevior vel subobsoletus, semper pilis carens.

A very distinct plant, with leaves somewhat like those of *Hemigenia Biddulphiana*, F. Muell., but the flowers are altogether different.

**WESTRINGIA CEPHALANTHA**, *F. Muell.* Between Broad Arrow and Uladdie, March. Gibraltar, October. A shrub 4 feet high or taller. Flowers white.

**W. RIGIDA**, *R. Br.* Gibraltar and Coolgardie, August and September. A small subshrub about 18 inches high. Flowers white.

### PLANTAGINEÆ.

**PLANTAGO VARIA**, *R. Br.* Creek N.W. of Wilson's pool, May. Near Coolgardie, August. Common in springtime in the Coolgardie district.

### CHENOPODIACEÆ.

**RHAGODIA BILLARDIERI**, *R. Br.* Neighbourhood of Gnarlbine, September. A bushy shrub, 3 feet high.

**R. BILLARDIERI**, *R. Br.*, var. LINEARIS. Gnarlbine, November. A small shrub, 3 feet in height, with green flowers.

**R. CRASSIFOLIA**, *R. Br.* Gibraltar district, September.

**R. CORALLIOCARPA**, *S. Moore, in Journ. Bot.* XXXV. (1897) p. 168. Kilkenny soak, June.

**R. SPINESCENS**, *R. Br.*, var. A small subshrub between Wilson's creek and Lake Darlôt, May. A form with very small linear to obovate leaves which are only 2–4 mm. in length. It may perhaps be a new species, but the specimens have already flowered. The berries are white and very small.

**DYSPHANIA LITTORALIS**, *R. Br.* Bullabulling, September.

**ATRIPLEX NUMMULARIA**, *Lindl.* Gibraltar, November. A common shrub in various parts throughout all the districts visited.

**A. VESICARIA ?**, *Heward.* Between Siberia soak and Mt. Margaret, and between Goongarrie and Mount Margaret, January.

Gibraltar, September. A subshrub usually about 2 feet or so high. The specimens are either in flower only or in the early fruiting stage. Hence the doubt about the name.

ENCHYLÆNA TOMENTOSA, *R. Br.* Near Kilkenny soak, June.

KOCHIA VILLOSA, *Lindl.* Between Wilson's creek and Lake Darlôt, May (flowers). Coolgardie district, August (fruit in various stages). A lowly subshrub, with yellow flowers and red and green samaras.

K. VILLOSA, *Lindl.*, var. Gibraltar and Coolgardie districts, spring. A variety with densely tomentose pink samaras. Perhaps better referred to one of the later described species of this difficult genus.

K. SEDIFOLIA, *F. Muell.* Between Doyle's well and Mt. George, June. A small erect subshrub, about 2 feet high. Samaras pale rose.

CHENOLEA SCLEROLÆNOIDES, *F. Muell.* Gibraltar, September (fruit).

SCLEROLÆNA BICORNIS, *Lindl.* Common in various parts of the interior. The specimens are from near Mt. George (June) and Coolgardie (August).

SALICORNIA ARBUSCULA, *R. Br.* Common near claypans and on salt-bush plains.

SALSOLA KALI, *Linn.* Between Broad Arrow and Uladdie, March. Occurs here and there in various places, but never in great quantity.

### AMARANTHACEÆ.

TRICHINIUM OBOVATUM, *Gaudich.* Near Kilkenny soak, June. Plain south of Doyle's well, June. Coolgardie district, August and September. This common Amaranth occurs in several varieties in various parts of the Goldfields.

T. ALOPECUROIDEUM, *Lindl.* Near Ninety-mile lake, June.

T. CORYMBOSUM, *Gaudich.* Between Broad Arrow and Uladdie, March. Bricke's soak, June. Coolgardie district, August.

T. EREMITA, sp. nov. Herbacea, pusilla, erecta, parum ramosa, foliis radicalibus et caulinis linearibus vel lineari-oblan-

ceolatis basi in petiolum attenuatis apice spinuloso-apiculatis piloso-puberulis vel vix glabris, spicis abbreviatis late ovoideis paucifloris, bracteis bracteolisque rotundato-ovatis breviter spinuloso-acuminatis tenuiter scariosis, perianthii straminei segmentis fere omnino liberis extra deorsum piloso-hirsutulis intus glabris, antheris minutis, ovario glabro.

*Hab.* Ad Gibraltar florebat mens. Sept.

Nec ultra 5·0 cm. alt., plerumque vero humilior. Radix simplex, tenuis. Folia pleraque 0·5–1·0 cm. long., 0·05–0·2 cm. lat., radicalia plerumque paullo majora, omnia in sicco læte viridescentia. Spicæ breviter pedunculatæ, circa 0·7 cm. long. et diam., 4–8-floræ. Bracteolæ vix 0·5 cm. long., glabræ. Perianthii segmenta oblonga, breviter acuminata, vix carinata, medio viridia ibique tantum pilifera, 0·7 cm. long., omnia piloso-hirsutula, sursum glabra. Filamenta complanata, basi nuda. Ovarium depresse sphæroideum, paullo ultra 0·1 cm. long. et diam. Stylus excentricus, quam ovarium 2plo longior, glaber. Stigmatis margo laceratus.

For a time I thought this might be a very greatly reduced form of *Trichinium corymbosum*, Gaudich., which, apart from the small size, it resembles superficially to a remarkable extent. On close examination, however, some well-pronounced differences come to light. Thus all the perianth-segments are hairy on the back, not the three outer ones alone, as is the case with *T. corymbosum*, which latter has anthers from four to ten times the size of those of *T. eremita* and longer filaments; its style also is much longer and the edge of the stigma entire, not lacerate. Moreover, though the ovary of *T. corymbosum* is said by Bentham to be glabrous, I find a fringe of long hairs attached near the top. The ovule also of *T. corymbosum* is quite different, being only half the relative width and oblong in shape, instead of broadly reniform; and this, if it be a constant character, points to a difference in the seed.

Trichinium helipteroides, *F. Muell.* Near Kilkenny soak, June. A form with small flower-heads.

T. Drummondii, *Moq.* Not infrequently seen in various parts of the interior north of Pendinnie soak, where it flowers in June. A form with very small heads barely half an inch in diameter. An intermediate form was collected by the Elder Expedition at various camps in the Victoria desert.

TRICHINIUM CARLSONI, *F. Muell.* Near Coolgardie, August. The flowers are sometimes yellow, sometimes orange-red.

T. HOLOSERICEUM, *Moq.* The Forty-five-mile, June. Coolgardie district, August. Some of the specimens vary from the typical habit, the stems shooting out to a length of 10–15 cm., and bearing numerous leaves as long as or longer than the radical ones.

### POLYGONEÆ.

RUMEX CRISPUS, *Linn.* Bullabulling, September. Probably introduced by teamsters.

POLYGONUM PROSTRATUM, *R. Br.* Near Kilkenny soak, June. A form with short ovate-lanceolate leaves, 1½–2 cm. in length.

### PROTEACEÆ.

PERSOONIA (§ AMBLYANTHERA) LEUCOPOGON, sp. nov. Suffruticosa sursum copiose foliata, foliis parvis imbricatis lineari-lanceolatis pungenti-acuminatis subsessilibus obscure 1-nerviis albido-tomentosis proventu dein minute furfuraceo-tomentellis, floribus solitariis brevipedunculatis, perianthiis dense ferrugineo-tomentosis, antheris a perianthii segmentis paullo superatis, connectivo obtuso, ovario glabro breviter stipitato, ovulis 2.

*Hab.* Repperi inter Uladdie et Yilgangie, ubi florescit mens. Mart.

Suffrutex circa ⅔-metralis. Ramuli circa 0·2 cm. diam., rigidi, sursum ramulosi, juniores appresse tomentosi proventu plus minus pubescentes. Folia circa 1·0 cm. long., vix 0·2 cm. lat., basi revera usque ad 0·1 cm. miniata, rigida, plus minus curvata, margine incrassata, pallida. Pedunculi 0·25 cm. long., dense ferrugineo-tomentosi. Flores lutei. Perianthium 1·0 cm. paullo excedens, utrinque angustatum. Glandula hypogyna minuta. Antheræ 0·5 cm. long.; connectivus apice haud apiculatus. Ovarii anguste ovoidei 0·175 cm. long. stipes vix 0·2 cm. attingens. Stylus pinguis, glaber, 0·6 cm. long. De fructu sileo.

This is a singular-looking plant, and not likely to be mistaken for any of its congeners. In habit it reminds one slightly of *P. angulata*, R. Br., but the tomentose leaves are very much smaller and twisted. This twist, which is well marked in the case of most leaves, probably has heliotropism for its cause.

The connective ends as a hardened obtuse point extending no further or at most a fraction of a millimetre further than the cells. Consequently the plant is rightly referred to the section *Amblyanthera.*

GREVILLEA NEMATOPHYLLA, *F. Muell.* Gnarlbine, November. Slender tall shrub, 10 feet high. Flowers cream-coloured, sweet-scented. Differs from the type chiefly in its longer leaves and broader spikes, though in these points my specimens more closely resemble those of the Elder Expedition, which are named as above. The West Australian plant should, perhaps, be regarded as a distinct species.

Fruits of this were secured, but the seeds had dropped from them. The follicle is ovate, to some extent bilaterally asymmetrical, and with a straight ventral suture. It is 1·5 cm. long and a little over 1 cm. wide.

G. (§ PLAGIOPODA) EXTORRIS, sp. nov. Fruticosa, sursum foliosa, ramulis pubescentibus mox glabris, foliis anguste linearibus apice pungentibus coriaceis planis appresse sericeo-pubescentibus puberulisve, glomerulis subsessilibus umbellatis axillaribus paucifloris, pedicellis quam perianthium brevioribus tomentellis mox appresse pubescentibus, perianthio extra appresse ferrugineo-hirsuto intus supra medium pulvinato-barbato ejus tubo a basi leviter ac sensim ampliato sub limbo attenuato, toro obliquo, glandula semilunari parum eminente, ovario breviter stipitato appresse albide sericeo-villoso, stylo perianthium multo excedente, stigmate laterali breviter conico.

*Hab.* Repperi inter Wilson's pool et lac. Darlôt mens. Maj florescentem.

Frutex humanæ altitudinis vel humilior. Rami leves, cinerei, deorsum nudi. Folia 5·0–7·0 cm. long., 0·2 cm. lat., deorsum sensim et leviter attenuata, subtus 4-canaliculata, rigida, glaucescentia. Pedunculi nec ultra 0·2 cm. long., plerique vero breviores, sericeo-tomentosi. Pedicelli modici 0·3 cm. long., sub flore amplificati. Perianthium circa 0·8 cm. long., purpurascens; limbus ejus globularis. Ovarium 0·13 cm. long., stipite 0·15–0·3 cm. long. fultum. Stylus usque ad 2·0 cm. long., plerumque vero brevior, glaber, sursum leviter attenuatus.

*G. haplantha*, F. Muell., has much the same inflorescence, but its leaves are different, being shorter, narrower, and not so

markedly channelled beneath; its perianths, too, are much broader, and the ovary, placed on a shorter stipe, is thickly covered with long coarse yellow hairs, and is crowned by a longer and pubescent or villous style.

**GREVILLEA (§ PLAGIOPODA) ACULEOLATA**, sp. nov. Fruticosa, copiose ramosa, ramulis pubescentibus mox glabris, foliis parvis linearibus apice pungenti-spinulosis margine arcte revolutis subtus sericeo-pubescentibus rigidis, glomerulis terminalibus paucifloris, pedicellis folia subæquantibus vel iis brevioribus, perianthio extra vix omnino glabro intus in toto pubescente deorsum gradatim ampliato sursum recurvo, toro obliquo, glandula planata, ovario glabro brevissime stipitato.

*Hab.* Legi inter Wilson's creek et lac. Darlôt, ubi flores rubros proferebat mens. Maj.

Ramuli rigidi, cinerei, in longitudinem rimosi. Folia approximata, 1·0 cm. long., 0·1 cm. lat., sessilia, supra fere glabra, deinde subnitentia, subtus pallida, patentia, rigide coriacea. Pedicelli vix usque ad 0·5 cm. long., ascendentes. Perianthii tubus circa 0·8 cm. long., deorsum vix 0·2 cm. diam., sursum usque ad 0·04 cm. coarctatus; lobi antheriferi ovati obtusi. Ovarii stipes 0·06 cm. long., tori margine superiore inserta. Ovarium 0·13 cm. et stylus crassiusculus 1·2 cm. long. Stigma obliquum, orbiculare, convexum.—Hujus exstat varietatem insequentem:

Var. LONGIFOLIA. Folia sparsa, 1·5–2·0 cm. long.

Inter Wilson's pool et lac. Darlôt mens. Maj floret.

To be distinguished from *G. acuaria*, F. Muell., chiefly in the different juniper-like leaves and the broader perianth pubescent within throughout, not bearded to below the middle only, and provided with a more prominent limb.

Except for its somewhat smaller leaves white underneath and the shorter and slenderer style, there is little to distinguish the present plant—and especially the var. *longifolia*—from the Elder Expedition plant referred to *G. acuaria*, which in all probability is a variety of the plant here described.

**G. (§ CALOTHYRSUS) SARISSA**, sp. nov. Fruticosa, ramulis pubescentibus deinde glabris, foliis elongatis anguste linearibus omnino integris apice spinuloso-pungentibus marginibus arcte revolutis glabris, racemis terminalibus abbreviatis paucifloris solitariis, perianthii glabri tubo a basi usque ad apicem sensim attenuato, toro obliquo, glandula parum eminente, ovario glabro stipiti elongato geniculatim inserto.

*Hab.* Ad Gibraltar florebat mens. Sept.

Frutex altitudinis innotatæ. Ramuli rigidi, sursum crebro foliosi. Folia erecta, 16·0 cm. long., 0·1 cm. lat., basibus aliquantulo dilatatis inserta, in sicco lutescenti-viridia. Florum rhachidis usque ad 1·0 cm. long., tomentosa. Flores patentes 1·5 cm. long., deorsum 0·4 sursum 0·2 cm. lat. Ovarii stipes 0·5 cm. long., tori apici insertus, parum curvatus. Ovarium 0·1 cm. long., stylo incrassato sursum sensim attenuato 1·0 cm. excedente coronatum. Stigma obliquum, convexum. Fructus ambitu ovatus, vix 1·5 cm. long.

The same plant is among the specimens brought back by the Elder Expedition. It has been called "*Grevillea Huegelii*," I cannot but think wrongly. The leaves of *G. Huegelii* are altogether different, its perianths are hairy and much smaller, the torus and gland are smaller, the stipe is thinner, the ovary smaller, and the smaller style is set straight upon the stipe and not geniculately.

The Elder Expedition specimens are of two kinds, shorter- and longer-leaved. The former, with leaves reduced to 7 cm. in length and sometimes bifurcate (in one case trifurcate), but then with narrow-linear lobes and thus quite unlike the leaves of *G. Huegelii*, may be distinguished as var. ***brevifolia*** of the species here established. The fruit has been described from Elder Expedition material at Kew.

HAKEA (§ GREVILLEOIDES) **SUBEREA**, sp. nov. (*H. lorea*, F. Muell. & Tate, non R. Br.). Arborea, foliis elongatis teretibus integris levibus, cicatricis punctis vascularibus ternis medio lateralibus approximatis a basi remoto, racemis axillaribus cylindricis densifloris, rhachide pedicellis perianthiisque dense stramineo-tomentosis, pedicellis perianthia haud excedentibus, perianthii tubo ampliato basi dilatato sursum revoluto, lobis obovatis obtusis, toro parum obliquo, glandula hypogyna magna hippocrepiformi, ovario subsessili.

*Hab.* Crescit in variis locis in solo granitico, mens. Apr. flores lacteos præbens.

Arbor usque ad sexmetralis cortice maxime crasso alte rimoso obducta. Ramuli angulati, dein subteretes, breviter tomentosi cito glabri. Folia hac atque illac congesta, usque ad 25·0 cm. long., apice pungentia, in sicco pallide virescentia. Racemi 7·0 cm. long. vel ultra; rhachis 0·2 cm. diam. Pedicelli 0·5–0·6 cm. long., patentes. Perianthium basi usque ad 0·3 cm. amplificatum;

phylla longe post anthesin cohærentia, 1·2 cm. long., lobi antheriferi alte excavati, 0·25 cm. long. Ovarii stipes 0·15 cm. long. Stylus crassus, deorsum 0·1 cm. diam., 1·7 cm. long. Stigma obliquum, conicum, rugatum.

Specimens of the same tree were obtained by Mr. Helms of the Elder Expedition in the Cavanagh and Barrow Ranges. In the report of that Expedition these specimens are referred to *Hakea lorea*, R. Br., a course I find it impossible to acquiesce in, at the same time feeling doubts as to whether there can be authentic specimens of *H. lorea* at Melbourne. Two congeners more easily separable it would be scarcely possible to find. The chief differences lie in the shorter and slenderer leaves of *H. suberea*, its short stout pedicels not longer than the perianths, the latter organs larger and much broader with a dilated base, the larger anthers, the bigger gland, subsessile ovary, and elongated stout style. Moreover the distribution of the vascular scars left upon the stem after the fall of the leaves, a point to which Meissner attaches importance, is different in the two, *H. suberea* being, in this respect, more like *H. Cunninghamii*, R. Br.

This tree was seen from the Black Gin soak, between Goongarrie and Mt. Margaret, northwards to our farthest point—some high granite rocks fourteen miles north of Lake Darlôt. Wherever it occurs, subterranean water is supposed to be somewhere in the vicinity, and experience has, so far I believe, justified the supposition.

My specimen—unfortunately only a single one and not very good—agrees perfectly with that of the Elder Expedition in the Kew Herbarium.

### THYMELEACEÆ.

PIMELEA TRICHOSTACHYA, *Lindl.* The Brook, Mt. Margaret, February.

P. MICROCEPHALA, *R. Br.* Between Wilson's pool and Lake Darlôt, May. Plain south of Doyle's well, and near Goongarrie, June. A small shrub about 3 feet high. Flowers yellow-green or dirty white.

P. (§ DITHALAMIA) THESIOIDES, sp. nov. Ramosissima, fere omnino glabra, foliis plerisque oppositis parvis sessilibus lineari-lanceolatis vel linearibus obtusis, capitulis parvis terminalibus plurifloris, involucri bracteis plerumque 4 foliis consimilibus nisi brevioribus et latioribus, floribus dioicis, perianthio masculo attenuato bracteas excedente glabro, perianthio fœmineo masculo vix subæquilongo deorsum ampliato sursum attenuato glabro.

*Hab.* Repperi inter Coolgardie et lac. Darlôt, sed ob schedulam prætermissam locum accuratius indicare nequeo.

Verisimiliter frutex deorsum nudus sursum creberrime ramosus. Ramuli diffusi, attenuati, angulati, ipsis sub capitulis sæpe piloso-puberuli. Folia 0·5–0·8 cm. long., 0·1–0·2 cm. lat., margine sub lente minute crenulato-undulata, in sicco flavescenti-viridia. Capitula 0·5–0·7 cm. diam., piloso-puberula vel breviter sericeo-villosa. Involucri bracteæ 0·4–0·7 cm. long., glabræ, usque ad 0·25 cm. lat., obtusæ vel acutæ, nonnunquam breviter acuminatæ. Flores verisimiliter virescentes. Perianthii masculi tubus 0·4 cm. long., 0·05 cm. lat.; limbi 0·25 cm. diam., lobi obovato-oblongi, obtusissimi, 0·13 cm. long. Perianthii fœminei tubus mox usque ad circa 0·4 cm. expansus, deorsum ad 0·1 cm. angustatus, sursum subito ad 0·03 cm. coarctatus, ejus lobi perbreves, late ovati, obtusissimi. Filamenta brevissima; antherarum connectivus angustus. Stigma breviter exsertum. Drupa nondum matura 0·3 cm. long.

Differs from *Pimelea microcephala*, R. Br., on account of its extremely ramose habit, smaller leaves, short glabrous male flowers, and entirely different female. For the same reasons, except the presence of hairs on the perianth and with the addition of larger more-flowered heads, it can readily be distinguished from *P. pauciflora*, R. Br.

## LORANTHACEÆ.

LORANTHUS LINEARIFOLIUS, *Hook.* Near Goose's soak. South of MacAuliffe's soak. Plain south of Doyle's well. All in June. The hosts were species of *Acacia* not in flower. Flowers red.

The same individual host at the Goose's soak also supported the following, viz.:—

L. MURRAYI, *F. Muell. & Tate*, var. PARVIFLORA *nob.* (*L. miniatus*, nob., in Journ. Bot. xxxv. (1897) p. 170.) Near Goose's soak and Kilkenny soak, June. Flowers pale greenish below, yellow or orange above. Berries dark red.

Since writing my memoir (*vide loc. cit.*) on the camel-fodder plants of West Australia, I have had the opportunity of seeing at Kew specimens of *L. Murrayi*, the affinity of which with my supposed new species, *Loranthus miniatus*, I had already alluded to. I find that the Elder Expedition specimen referred to *L. Murrayi* has the peculiar habit of mine, viz., leaves crowning subobsolete branches; and as the flowers, except for their reduced size, are essentially similar to those of typical *L. Murrayi*, it would be better to consider the West-Australian plant as a small-flowered variety of the South Australian.

LORANTHUS LINOPHYLLUS, *Fenzl.* Siberia soak, January. Between Yilgangie claypans and Pendinnie soak, March. Flowers red.

L. PENDULUS, *Sieb.*, var. PARVIFLORA. Near Mount Malcolm, June. Parasitic on the Quandong (*Fusanus persicarius*), and homoplastic with it. Flowers red.

L. QUANDANG, *Lindl.* Wilson's creek, and creek between Wilson's pool and Lake Darlôt, April. The host is a *Grevillea*, probably *G. aculeolata*, S. Moore. Perianth green; stamens red.

A flowerless specimen, apparently to be referred to this species, was found growing on an *Acacia* out of flower. It was strikingly homoplastic with its host.

L. NESTOR, *S. Moore, in Journ. Bot.* xxxv. (1897) p. 170. Near Bricke's soak, between Goongarrie and Mount Margaret.

### SANTALACEÆ.

SANTALUM LANCEOLATUM, *R. Br.* The Brook, Mt. Margaret, February. A branching shrub, 8–10 feet high. Flowers and fruit yellow-green.

FUSANUS PERSICARIUS, *F. Muell.* A shrub up to 6 or 8 feet. Common in various districts. The "Quandong."

F. SPICATUS, *R. Br.* Common from Pendinnie northward. The red flowers appear from February to May. "Sandalwood."

EXOCARPUS APHYLLA, *R. Br.* Gibraltar, September. Not an uncommon shrub in various districts.

### EUPHORBIACEÆ.

MONOTAXIS LUTEIFLORA, *F. Muell.* Between Broad Arrow and Uladdie, March.

**Phyllanthus lacunaris**, *F. Muell.* Donkey rocks, between Goongarrie and Mt. Margaret, June.

### Urticaceæ.

**Parietaria debilis**, *Forst.* Nine-mile rocks near Coolgardie, August.

## MONOCOTYLEDONES.

### Orchideæ.

**Thelymitra longifolia**, *Forst.* Gnarlbine, September.

**Th. antennifera**, *Hook. f.* Gnarlbine, September.

**Pterostylis pyramidalis**, *Lindl.* Nine-mile rocks near Coolgardie, August.

### Liliaceæ.

**Dianella revoluta**, *R. Br.* Gibraltar, September.

**Anguillaria dioica**, *R. Br.* Between Wilson's creek and Lake Darlôt, May. Kilkenny soak and Donkey rocks, June. Most of the specimens have short sheathing bracts and solitary octamerous and always hermaphrodite flowers.

**Arthropodium curvipes**, sp. nov. Vix $\frac{1}{4}$-metralis, radicibus ?, foliis linearibus, circa 10·0 cm. long. et 0·2 cm. lat., pedicellis plerisque binis deinde recurvis, bracteis foliis similibus nisi multo brevioribus, antheris quam filamenta brevioribus his vix omnino dense lanatis, ovario cylindrico-oblongo.

*Hab.* Prope Coolgardie flores purpureos profert mens. Aug.

Near *A. paniculatum*, R. Br., and *A. minus*, R. Br.; the three being distinguishable in the following way:—

*A. paniculatum.* Flowers usually two or three to each bract. Bracts minute. Filaments tomentose in their upper half only. Anthers linear-oblong, more than half as long as the filaments. Ovary ovoid. Style long and slender.

*A. minus.*—Flowers smaller than those of *A. paniculatum* and usually solitary. Bracts 5–10 mm. long. Filaments tomentose to a little below the middle. Anthers oblong, half as long as the filaments. Ovary ovoid. Style short and comparatively thick.

*Arthropodium curvipes.* Flowers of *A. minus*, but usually two to each bract. Bracts up to 15 mm. in length. Filaments tomentose almost to the bottom. Anthers oblong, small, about a quarter the length of the filaments. Ovary cylindric-oblong. Style short and comparatively thick.

THYSANOTUS PATERSONI, *R. Br.* Gibraltar, October.

BORYA NITIDA, *Labill.* Between Southern Cross and Siberia soak, January. Nine-mile rocks near Coolgardie, August. Seen also on other gnamma-rocks.

### JUNCACEÆ.

XANTHORRHŒA, sp. A grass-tree or "black-boy"—probably *X. Preissii*, Endl.—was seen sparingly in a narrow strip of country between Southern Cross and Siberia. A few individuals were also seen between Uladdie and Yilgangie. Specimens were not brought down.

JUNCUS BUFONIUS, *Linn.* Bullabulling rocks, September.

### CENTROLEPIDÆ.

CENTROLEPIS MUTICA, *Hieron.* Bullabulling, September.

### CYPERACEÆ.

SCIRPUS CARTILAGINEUS, *Spreng.* Bullabulling, September.

S. CERNUUS, *Vahl.* Nile-mile rocks near Coolgardie, August. Bullabulling, September. The spikelets are longer than those of specimens from other parts of Australia, though not than those of some exotic specimens, as Mr. C. B. Clarke showed me.

### GRAMINEÆ.

PANICUM LEUCOPHÆUM, *H. B. K.* Siberia soak, January. Creek between Wilson's pool and Lake Darlôt, May.

P. GRACILE, *R. Br.* Between Southern Cross and Mt. Margaret.

ARISTIDA ARENARIA, *Gaudich.* Bullabulling, September.

STIPA SCABRA, *Lindl.* Near Coolgardie, August.

S. ELEGANTISSIMA, *Labill.* Near Coolgardie, August Gibraltar, September.

STIPA HEMIPOGON, *Benth.* Gibraltar district, September.

DEYEUXIA FORSTERI, *Benth.* Bullabulling, September.

DANTHONIA SETACEA, *R. Br.* Gibraltar, September.

PAPPOPHORUM NIGRICANS, *R. Br.* Between Broad Arrow and Uladdie soak, March (the form with pale glumes, *P. pallidum*, R. Br.). Near Wilson's pool, May (typical form).

ERIACHNE OVATA, *Nees*, var. NANA, *nob.* Coolgardie, August. Gibraltar, September. These are dwarf specimens to which there is nothing similar, neither at the British Museum nor at Kew. The tallest of them is only some half-a-foot high, the smallest barely an inch.

E. OBTUSA, *R. Br.* Siberia soak, January. Leaves very pungent pointed, more so than in the type-specimens.

ERAGROSTIS CHÆTOPHYLLA, *Steud.* Between Broad Arrow and Uladdie, March.

BRIZA MAXIMA, *Linn.* Gnarlbine, September. Probably introduced by teamsters.

BROMUS ARENARIUS, *Labill.* Near Coolgardie, August.

TRIODIA IRRITANS, *R. Br.* Frequent in various parts north of the thirtieth parallel: rarer in the south. "Spinifex." Specimens were not brought down.

## GYMNOSPERMÆ.

### CONIFERÆ.

FRENELA ROBUSTA, *A. Cunn.* Between Wilson's pool and Lake Darlôt. Shrub, about 8 feet or more high, with pyramidal habit.

## CRYPTOGAMIA.

### FILICES (det. J. G. Baker).

CHEILANTHES SIEBERI, *Kunze.* Creek between Wilson's pool and Lake Darlôt.

NOTHOLÆNA DISTANS, *R. Br.* Donkey rocks between Goongarrie and Mt. Margaret.

NOTHOLÆNA VELLEA, *R. Br.* Between Wilson's pool and Lake Darlôt.

GYMNOGRAMME POZOI, *Kunze.* Near Siberia soak. Nine-mile rocks near Coolgardie. Bullabulling.

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## STATISTICS OF THE WEST AUSTRALIAN DESERT FLORA.

Thanks mainly to the labours of the late Baron von Mueller, who has given us descriptions of the plants brought down by travellers in the interior of the Colony from the time of Forrest and Giles until his lamented decease, supplemented by contributions by Professor Tate, Mr. Luehmann, and myself, we are now in a position to form some idea of the flora of the West Australian interior as a whole. For my present purpose, I have collected all the references I could find to species having their habitat east of the 118th degree of longitude; but as this line passes close to Albany, I have, so far as concerns the country south of the 32nd parallel, taken the line of 119° as forming the western boundary of the desert, which extends eastward to the boundary of South Australia in long. 129°, and northward to the Tropic of Capricorn. So far as known, the flora of this district, some 450,000 square miles in extent, comprises 867 species, a number no doubt exceedingly small in view of the immense area indicated above; but when we consider how small a part of the interior has been scientifically explored—of the northern parts we know next to nothing—and consider also that every traveller has brought down with him a fair proportion of new species, there is justification for the belief that many species still remain to be discovered. I venture to think, therefore, that at least eleven or twelve hundred species will eventually be obtained from this part of Australia, and this is a considerable number, bearing in mind the extremely scanty rainfall.

In his 'Handbook of the Flora of Extratropical South Australia,' Professor Tate demarcates the area occupied by the *Eremian* or desert flora of that Colony. The region held by this Eremian flora corresponds with the "salt-bush" country of the pastoralist, and is approximately delineated by the rainfall line of ten inches. South of this line, that is, in the more humid districts, and except in the extreme south, the *Euronotian* flora is met with. The Eremian region is further subdivided into several smaller areas; but the only ones having special interest for us here are a northern and a central, the dividing line between which runs through Charlotte Waters (lat. 26° S.). In his Report on the Work of the Horn Scientific Expedition to Central Australia, Professor Tate proposes to shift this last-mentioned line to the latitude of Engoordina. To the north of this lies the *Larapintine* region; it extends to the Macdonnel ranges, close to the Tropic of Capricorn. The central Eremian region has for its dominant feature the prevalence of Salsolaceous plants; these are replaced in the Larapintine by grasses, of which order the "spinifex" is a characteristic member. Species representative of the Larapintine flora's arboreous vegetation are *Brachychiton Gregorii* (*Sterculia diversifolia*), *Eucalyptus* (*terminalis* and *Oldfieldii*), *Canthium latifolium*, *Grevillea striata*, *Ficus platypoda*, *Casuarina Decaisneana*, *Livistona Mariæ*, *Encephalartos Macdonnelli*, &c.; while *Cassia phyllodinea* and *Eucalyptus rostrata* here respectively replace *C. eremophila* and *E. microtheca* of the central region. How far the West Australian desert flora agrees with that of the neighbouring Colony it is impossible to say in the present state of our knowledge. Several scientific expeditions have penetrated the solitudes of South Australia from south to north almost to the Tropic of Capricorn; but hitherto travellers in the West Australian desert have moved either east or west or approximately so. The most northerly point reached by us was, as near as possible, in 27°·5 lat.; so that, supposing the floristic boundaries to run roughly east and west, we did not arrive within the Larapintine region at all. The bulk of the plants brought down by me are therefore central Eremian and not Larapintine; but some approach to the Larapintine flora is announced by the presence, in the northern parts of the district visited by me, of the "spinifex" plains already alluded to, although the occasional abundance of "salt-bush" there shows that we were still within the central Eremian boundary. I have, however, found records of several Larapintine plants which pass over into northern portions of the West Australian desert, and of these a list will presently be given.

My sources of information are the following:—

1. Mr. Bentham's 'Flora Australiensis.'
2. Baron von Mueller's lists of plants collected by Mr. Ernest Giles (Journ. Bot. xv. 1877).

3. The 'Fragmenta Phytographiæ Australiæ,' the Second Systematic Census of Australian Plants, and various other contributions of the same author.
4. The Report of the Elder Expedition: Botany, by Baron von Mueller and Professor Tate.
5. Mr. Luehmann's 'Reliquiæ Muellerianæ.'
6. My own collection.

Of the 867 species comprising the flora, 7 only are vascular Cryptogams, the rest being Phanerogams. The Phanerogams include 1 Gymnosperm, 91 Monocotyledones, and 768 Dicotyledones, the proportion of the latter to the former being as 8·4 to 1. That is to say, while 89·3 per cent. of the flora is dicotyledonous, only 10·59 per cent. is monocotyledonous *. These 860 Phanerogams, disposed among 73 orders, are distributed among 319 genera, giving an average of only 2·7 species per genus †; and while 180 of the genera (56·42 per cent.) are also extra-Australian, 139 (43·57 per cent.) are confined to the island-continent. No less than 146 of the species, or 17 per cent., are endemic in the West Australian desert.

There are no natural orders peculiar to the desert, neither is there much reciprocal ordinal exclusion in the parts of it respectively north and south of 30°. I find records of 8 natural orders confined to the desert north of 30°, and of as many which, at the present time, are not known to overstep that parallel in a northward sense. The exclusively northern orders are as follows:—

1. *Capparideæ*. Represented by ***Polanisia viscosa***, Linn., a common weed in tropical and warmer extratropical Australia, but not reported from the S.W. corner ‡.
2. *Cucurbitaceæ*. This order has two representatives, which advance no further than the Ashburton district.
3. *Araliaceæ*. As the last, but with one representative only.
4. *Jasmineæ*. Comes as far south as the Murchison.
5. *Bignoniaceæ*. One species (*Tecoma australis*, R. Br.) widely

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* This is a very low proportion. *Cfr.* Hemsley (Biol. Centr.-Amer. vol. i. p. xix), who finds that Europe and four other areas have from 17·32 to 23·43 per cent. of Monocotyledones, while Australia has 18·5 per cent.

† Hemsley (*l. c.* p. xxiii) gives the following numbers of species per genus:—in India 6·0; in Mexico 6·4; in N. America 6·2; in Australia 6·4. The low proportion of species per genus in the West Australian desert is in accordance with the rule which prevails in the case of all small floras.

‡ The term "S.W. corner" is used to denote the tract of land lying south of 30°, and west of the desert as already defined.

distributed in Australia, but absent from the S.W. corner. Reported from the Barrow Range, at the eastern limit of the W. Australian desert.

6. *Acanthaceæ.* Represented by two species which advance no further south than the Ashburton.
7. *Nyctagineæ.* Of *Boerhaavia diffusa*, found all over Australia including the S.W. corner, I find no record from the desert south of 30°. Most probably it has been overlooked.
8. *Fluviales.* One representative found in extratropical Australia, including the S.W. corner.

I find no desert records north of 30° in respect of the following orders:—

1. *Dilleniaceæ.* Probably overlooked. A thorough examination of the Murchison district would probably bring to light some members of this order.
2. *Tremandreæ.*
3. *Geraniaceæ.* Probably overlooked.
4. *Loganiaceæ.* Ditto.
5. *Gentianeæ.* Represented by one species of wide distribution. A probable oversight.
6. *Orobancheæ.* One widely distributed species.
7. *Irideæ.* One genus (*Patersonia*); but inasmuch as this is also known from Borneo, it should be found in the desert N. of 30°.
8. *Centrolepidæ.* Probably overlooked.

Of the **180** exotic* genera:—

**154** are the more widely distributed outside Australia.

**4** [*Eriostemon*, *Duboisia*, *Xerotes*, *Grevillea* (which is in New Guinea as well)] are common to Australia and New Caledonia.

**3** [*Styphelia*, *Banksia*, *Kennedya*] are common to Australia and New Guinea.

**13** [*Phebalium*, *Plagianthus*, *Swainsona*, *Clianthus*, *Pomaderris*, *Brachycome* (also in S. Africa), *Olearia*, *Logania*, *Pimelea*, *Persoonia*, *Fusanus*, *Pterostylis*, *Arthropodium*] are common to Australia and New Zealand.

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* This term is applied simply to genera and species occurring in Australia and beyond its borders, and without any implication as to an assumed place of origin.

**6** [*Hibbertia* (Madagascar, also New Caledonia), *Keraudrenia* (Madagascar), *Helipterum* (Cape of Good Hope), *Brachycome* (also N. Zealand), *Cryptostemma* (a Cape introduction), *Cæsia* (Cape of Good Hope)] are common to Australia and Africa.

Of the endemic genera:—

**117** are more or less widely distributed in Australia.

**16** [*Menkea, Sollya, Wehlia, Balaustion, Calathamnus, Pileanthus, Microcorys, Oligarrhena, Stirlingia, Dryandra, Synaphea, Calycopeplus, Conostylis, Anigozanthes, Tribonanthus, Anarthria*] are confined to Western Australia.

**4** [*Petalostylis, Astrotriche, Bertya, Astrebla*] are not found in the S.W. corner.

**2** [*Hemiphora, Wrixonia*] are endemic in the Western Australian desert.

Of the **860** species:—

**273** are at present known to occur north of 30° alone.
**367** ,, ,, ,, south ,,
**220** have been met with both north and south of 30°.

The species may be thus arranged:—

### A. SPECIES ENDEMIC IN AUSTRALIA.

*a.* **146** are endemic in the West Australian desert. Of these:

**41** have been found north of 30° alone.
**79** ,, ,, south ,,
**26** ,, ,, both north and south of 30°.

*b.* **36** are restricted to the Larapintine region of South Australia and the West Australian desert.

**28** of these have occurred in the West Australian desert north of 30° alone.

**4** of these have occurred in the West Australian desert south of 30° alone.

**4** of these have occurred in the West Australian desert both north and south of 30°.

*c.* **4** [*Keraudrenia integrifolia, Helipterum Fitzgibboni, Lobelia heterophylla, Eucalyptus pyriformis* (this is also found in the Lake Torrens basin)] extend from the Larapintine region through the desert, and more or less into the S.W. corner.

*d.* **111** are endemic in S.W. Australia both north and south of 30°. Of these:

**39** occur in the desert north of 30° alone.
**49** „ „ south „
**23** „ „ both north and south of 30°.

*e.* **14** desert species are endemic in S.W. Australia north of 30° alone.

**8** of these have been found in the desert north of 30° alone.
**2** „ „ „ „ south „
**4** „ „ „ „ both north and south of 30°.

*f.* **108** desert species are endemic in S.W. Australia south of 30° alone. Of these:

**15** have been found in the desert north of 30° alone.
**76** „ „ „ south „
**17** „ „ „ both north and south of 30°.

Thus **233** species of the West Australian desert are endemic in S.W. Australia. This is roughly one-quarter of the flora.

And **379** species—roughly five-twelfths of the flora—are either restricted to the desert alone, or advance more or less into the S.W. corner of Australia, and have not been met with outside these limits.

*g.* **27** species of the West Australian desert range through both Western and South Australia, and in the main south of 30° in both Colonies.

**6** of these have been found in the West Australian desert north of 30° alone.
**17** of these have been found in the West Australian desert south of 30° alone.
**4** of these have been found in the West Australian desert both north and south of 30°.

*h.* **7** species have a similar distribution to those under *g*, except that they range north of 30° in both Colonies. All of these have been met with in the West Australian desert north of 30° alone.

*i.* **9** species are endemic in the West and South Australian deserts mainly south of 30°, and do not advance into the S.W. corner. Of these:

**3** [*Haloragis acutangula*, *Helichrysum Lawrencella*, *Prostanthera Wilkieana*] have been found in West Australia north of 30° alone.

**5** [*Melaleuca quadrifaria*, *Baeckia crassifolia*, *Helipterum Troedelii*, *Helichrysum Tepperi*, *Helipterum heteranthum*] have been found in West Australia south of 30° alone.

**1** [*Schœnia Cassiniana*] is endemic both north and south of 30°.

*k*. **11** species are endemic in tropical Western Australia, whence they advance into the northern part of the West Australian desert.

**9** of these [*Tribulus platypterus*, *Abutilon amplum*, *Gossypium Robinsoni*, *Astrotriche Hamptoni*, *Goodenia azurea*, *Velleia panduriformis*, *Clerodendron lanceolatum*, *Eremophila Fraseri*, *Pimelea Forrestiana*] are found in the desert north of 30° alone;

and **2** [*Stackhousia Brunonis*, *Solanum lasiophyllum*] advance south of 30°.

*l*. **2** species [*Ptilotus hemisteirus*, *Gyrostemon ramulosus*], with the same distribution as those under *k*, extend into the S.W. corner and also into South Australia.

*m*. **3** species [*Goodenia heterochila*, *G. microptera*, *Jasminum calcareum*] are endemic in tropical Western Australia, whence they pass into the northern fringe of the desert and on to the Larapintine region of South Australia.

*n*. **98** species are endemic in tropical and subtropical (or temperate) Australia, and occur also in the West Australian desert. Of these:

**51** advance to the S.W. corner of Australia.

**47** are not found in the S.W. corner.

Of the 51, **9** are not known from the West Australian desert south of 30°;

**11** are not known north of 30°;

while **31** occur both north and south of 30° in the desert.

Of the 47, **23** have been found in the desert north of 30° alone.

**11** „ „ „ south „

**13** „ „ „ both north and south of 30°.

*o.* **111** desert species are species endemic in extratropical Australia, including the S.W. corner. Of these:

**17** are known from the desert north of 30° alone.
**50** ,, ,, ,, south ,,
**44** ,, ,, ,, both north and south of 30°.

*p.* **10** species endemic in extratropical Australia, and in the extratropical coast-region of West Australia, advance into the West Australian desert, but not to the S.W. corner. Of these:

**5** are known from the desert north of 30° alone.
**3** ,, ,, ,, south ,,
**2** ,, ,, ,, both north and south of 30°.

*q.* **21** species endemic in extratropical Australia including the the S.W. corner, and extending into the desert, are not known from the coast-region of the Western Colony north of 30°. Of these:

**3** are found in the desert north of 30° alone.
**17** ,, ,, south ,,
**1** occurs in the desert to the north and south of 30°.

*r.* **66** species endemic in extratropical Australia advance into the West Australian desert, but are not found either in the S.W. corner or in the coastal region of West Australia. Of these:

**22** occur in the desert north of 30° alone.
**27** ,, ,, south ,,
**17** ,, ,, both north and south of 30°.

*s.* **3** species [*Sida cardiophylla*, *Euxolus interruptus*, *Gomphrena canescens*] are endemic in tropical Australia, and pass into the northern part of the West Australian desert.

*t.* **3** species [*Mirbelia oxyclada*, *Indigofera enneaphylla*, *Casuarina Decaisneana*], endemic in tropical Australia, pass thence into the Larapintine region of South Australia and into the northern part of the West Australian desert.

*u.* **8** species endemic in tropical Australia extend thence into the Larapintine region of South Australia and into the West Australian desert. Of these:

6 [*Tribulus macrocarpus, Sida inclusa, Acacia patens, A. pyrifolia, Dicrastylis ochrotricha, Pimelea ammocharis*] are known from the desert north of 30° alone.

2 advance into the desert south of 30°.

*v.* **9** species are endemic in temperate Australia north of 30° and extend into the West Australian desert but not to the S.W. corner. Of these:

7 are known from the desert north of 30° alone.

2 advance into the desert south of 30°.

### B. SPECIES NOT PECULIAR TO AUSTRALIA.

*a.* **9** species [*Polanisia viscosa, Ionidium enneaspermum, Polycarpæa indica, Malvastrum spicatum, Vigna lutea, Drosera indica, Trianthema crystallinum, Cucumis acidus, Melothria maderaspatana*] are found in the tropics of the Old and New World, and reach tropical and subtropical Australia, and the north and north-east outskirts of the West Australian desert, but not the S.W. corner of the Colony.

*b.* **9** exotic species occur in tropical and extratropical Australia, including the S.W. corner. (The extra-Australian distribution of these is indicated below.) Of these:

1 [*Sporobolus virginicus* (Asia, Africa, America)] occurs in the desert north of 30° alone.

5 [*Tetragonia expansa* (Japan, N. Zealand, Polynesia, extratropical S. America), *Gnaphalium japonicum* (Asia, N. Zealand), *Orobanche cernua* (India, Mediterranean), *Scirpus cartilagineus* (Africa, N. Zealand), *Anthistiria ciliata* (Asia and Tropical Africa] are known from the desert south of 30° alone.

3 [*Hypericum japonicum* (Asia, N. Zealand), *Wahlenbergia gracilis* (East Indies, N. Zealand), *Trichodesma zeylanicum* (Tropical Asia and Africa, Polynesia] occur in the desert both north and south of 30°.

*c.* **1** species [*Lepidium ruderale*] occurs in all parts of Australia, including the S.W. corner, and in Europe, the Orient, and temperate Asia.

*d.* **5** species are found in extratropical Australia, including the S.W. corner and the desert, and also in New Zealand. Of which:

- **3** [*Microseris Forsteri, Deyeuxia Forsteri, Agropyrum scabrum*] occur in the West Australian desert south of 30° alone; while
- **2** [*Senecio lautus, Juncus pallidus*] occur in the desert both north and south of 30°.

*e.* **2** species [*Mesembryanthemum australe, Thelymitra longifolia*] range over extratropical Australia, including the S.W. corner and the desert south of 30°, and extend to New Zealand and Polynesia.

*f.* **1** species [*Tillæa verticillaris*] is extratropical Australian, including the S.W. corner and the desert both north and south of 30°, and extends into New Zealand and extra-tropical South America.

*g.* **13** species of wide extra-Australian distribution are widely distributed in Australia including the S.W. corner and the desert. Of these:

- **3** [*Tribulus terrestris, Gnaphalium luteo-album, Boerhaavia diffusa*] are known from the desert north of 30° alone.
- **7** [*Alyssum linifolium, Spergularia rubra, Oxalis corniculata, Erythræa spicata, Limosella aquatica, Juncus bufonius, Scirpus cernuus*] do not advance in the desert north of 30°.
- **3** [*Dodonæa viscosa, Salsola Kali, Parietania debilis*] occur in the desert both north and south of 30°.

*h.* **1** species [*Rhynchosia minima*] has the distribution given under *g*, but excluding the S.W. corner.

*i.* There remain **11** species, all of which, with two possible exceptions, are introductions. They are *Raphanus sativus, Silene gallica, Erodium cicutarium, Malva parviflora, Medicago denticulata, Sonchus oleraceus* [?], *Cryptostemma calendulacea, Senecio vulgaris* [?], *Anagallis arvensis, Rumex crispus*, and *Briza maxima.*

The species may be further arranged in tabular form in the following manner:—

### A. ENDEMIC* SPECIES.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Restricted to the West Australian desert ........... | **146** | Restricted to Western Australia: | **390** (45·3 °/o) | Confined to the W. Australian desert: | **146** (17 °/o). | Species restricted to Australia: | **807** (93·83 °/o). |
| Extending from the S.W. corner into the desert... | **233** | | | Desert species found also in non-desert regions of Western Australia, and extending into other parts of Australia ........... | **562** (65·3 °/o). | | |
| ,, ,, N.W. tropics into the desert... | **11** | | | | | | |
| Endemic in the S.W. corner, the West Australian desert, and South Australia ........................ | **43** (5 °/o). | | | | | | |
| Restricted to the desert regions of West and South Australia ................................................ | **45** (5·2 °/o). | | | | | | |
| Species ranging more or less widely over Australia, including the S.W. corner ........................... | **230** (27 °/o). | | | | | | |
| Species ranging more or less widely over Australia, but absent from the S.W. corner ................. | **99** (11·5 °/o). | | | | | | |

### B. EXOTIC* SPECIES.

| | | | | | |
|---|---|---|---|---|---|
| Desert species with wide Australian distribution ........................... | **42** (4·88 °/o). | Found also in the S.W. corner: | **31** (3·6 °/o). | Total of exotic and introduced species: | **53** (6·16 °/o). |
| | | Absent from the S.W. corner: | **11** (1·2 °/o). | | |
| Introduced species .................................. | **11** (1·2 °/o). | | | | |

In the present state of our knowledge these figures must be regarded as tentative merely. All that is claimed for them is that they show roughly, at a glance, the composition of the flora as it is known to-day.

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* The terms "Endemic" and "Exotic" are here used not as implying the place of origin of a species, but solely with reference to present distribution, within Australia alone in the former case, and beyond Australia in the other.

The species endemic in the W. Australian desert North of lat. 30° are the following:—

Burtonia simplicifolia.
Phyllota humilis.
Jacksonia rhadinoclada.
Acacia sclerosperma.
„ quadrimarginea.
„ denticulosa.
Cryptandra petræa.
Thryptomene Helmsii.
„ trachycalyx.
Wehlia coarctata.
Calythrix brevicollis.
„ plumulosa.
Baeckia ochropetala.
Eucalyptus Rameliana.
Canthium suaveolens.
Helichrysum Gilesii.
Humea gracillima.
Velleia Daviesii.
„ rosea.
Stemodia linophylla.
Hemigenia brachyphylla.
Hemigenia exilis.
Prostanthera Eckerslyana.
Wrixonia prostantheroides.
Chloanthes halganiacea.
Eremophila Forrestii.
„ Margarethæ.
„ punicea.
„ metallicorum.
Pholidia homoplastica.
Rhagodia coralliocarpa.
Loranthus Nestor.
Banksia Elderiana.
Persoonia diadema.
„ Leucopogon.
Grevillea extorris.
„ aculeolata.
„ eriobotrya.
„ apiciloba.
„ erectiloba.
Schœnus hexandrus.

The following are endemic in the W. Australian desert South of lat. 30°:—

Menkea coolgardiensis.
Lepidium Merrallii.
Comesperma viscidulum.
Tetratheca Harperi.
Plagianthus repens.
„ Helmsii.
Sida Kingii.
Rulingia coacta.
Oxylobium graniticum.
Mirbelia microphylloides.
Phyllota lycopodioides.
Daviesia Croniniana.
Dillwynia acerosa.
Cassia cardiosperma.
Acacia lachnophylla.
„ sibirica.
„ Dempsteri.
Pomaderris Forrestiana.
„ intangenda.
Trymalium Myrtillus.
Darwinia Luehmanni.
Verticordia Rennieana.
„ Helmsii.
Calythrix Watsoni.
„ Birdii.
„ desolata.
Thryptomene hymenonema.
„ urceolaris.
Baeckia cryptandroides.
Leptospermum Roei.
Eucalyptus Campaspe.
„ torquata.
„ corrugata.
„ Youngiana.

Eucalyptus orbifolia.
Didiscus Croninianus.
Trachymene juncea.
Athrixia chætopoda.
Elachanthus occidentalis.
Gnephosis intonsus.
Helichrysum puteale.
„ Cassiope.
Helipterum Battii.
„ oppositifolium.
„ Zacchæus.
„ verecundum.
Stylidium limbatum.
Scævola oxyclona.
Goodenia Elderi.
„ Watsoni.
„ mimuloides.
Styphelia Kingiana.
Solanum nummularium.
Anthocercis Odgersii.
Chloanthes Elderi.
„ Depremesnilii.
„ Teckiana.
Chloanthes cærulea.
Hemiphora Elderi.
Newcastlia hexarrhena.
Eremophila Dempsteri.
„ granitica.
Pholidia saligna.
„ cærulea.
„ Veronica.
„ interstans.
Halgania rigida.
„ viscosa.
Trichinium eremita.
„ Carlsoni.
Kochia glomerifolia.
Grevillea Sarissa.
„ Helmsiana.
Calycopeplus Helmsii.
Monotaxis luteiflora.
Bertya quadrisepala.
Casuarina acutivalvis.
Cæsia rigidifolia.
Arthropodium curvipes.

### Species endemic in the W. Australian desert both North and South of lat. 30°.

Commersonia craurophylla.
„ melanopetala.
Jacksonia nematoclada.
Gastrolobium seorsifolium.
Isotropis canescens.
Daviesia acanthoclona.
Aotus Tietkiensii.
Phyllota Luehmanni.
Burtonia gompholobioides.
Haloragis confertifolia.
Darwinia purpurea.
Thryptomene stenocalyx.
Melaleuca leiocarpa.
Beaufortia interstans.
Goodenia xanthosperma.
Velleia discophora.
Dampiera luteiflora.
Prostanthera Grylloana.
Dicrastylis Nicholasii.
Chloanthes stachyodes.
„ loricata.
Newcastlia chrysotricha.
Eremophila Youngii.
Conospermum Toddii.
Bertya dimerostigma.
Casuarina corniculata.

## SOME NOTEWORTHY POINTS AS TO THE CONNECTIONS OF THE DESERT FLORA.

### A. *Connection between the West Australian Desert and New Guinea**.

Exclusive of widely diffused genera of Grasses and Sedges, **57** phanerogamous genera of the desert are also found in New Guinea. Of these:

**3** only (*Kennedya*, *Styphelia*, and *Banksia*) are absolutely restricted to Australia and New Guinea; they are all represented in the desert, but the species are not identical.

**2** genera (*Grevillea*, *Xerotes*) are restricted to Australia, New Guinea, and New Caledonia, while *Arthropodium* is found in New Zealand as well; all the desert species are different from those of New Guinea.

**2** genera (*Olearia*, *Pimelea*) occur in New Zealand as well as in Australia and New Guinea; but the former of these should more properly be merged into the widely distributed genus *Aster*.

**2** more (*Vittadinia* and *Muehlenbeckia*) are native in America, as well as in Australia, New Guinea, and New Zealand.

Of the **57** genera **40** have a more or less wide range in the Old World outside Australia; while **7** of them (*Commersonia*, *Baeckia*, *Melaleuca*, *Eucalyptus*, *Stylidium*, *Scævola*, and *Casuarina*) are pre-eminently Australian.

The above 57 genera have **124** New Guinea species, of which only **20** are confined to Australia and New Guinea, while **48** others which occur in Australia are also of more or less wide extra-Australian distribution.

Only **11** species are common to the West Australian desert and New Guinea, viz.:—

*Polanisia viscosa*, *Ionidium enneaspermum*, *Tribulus terrestris*, *Oxalis corniculata*, *Drosera indica*, *Melothria maderaspatana*, *Eucalyptus terminalis*, *Gnaphalium luteo-album*, *Wahlenbergia*

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* Bibliography: Baron Mueller's 'Descriptive Notes on Papuan Plants.' The same writer's 'Record of Observations on Sir William MacGregor's Highland Plants from New Guinea.' Schumann & Holrung, 'Die Flora v. K. Wilhelms Land.'

*gracilis*, *Evolvulus linifolius*, and *Euxolus interruptus.* Of these:

3 are not found in the South-west corner, one of them (*Evolvulus linifolins*) being of wide extra-Australian distribution; while *Eucalyptus terminalis* and *Euxolus interruptus*, which do not extend beyond New Guinea, only reach the northern and eastern outskirts of the desert. The rest are widely distributed plants.

*Indigofera linifolia*, a species widely diffused in Australia, is the only one, so far as I have been able to find out, which is common to New Guinea and Australia, including the South-west corner, yet is not known to occur in the intervening desert.

### B. *The Connection with Africa is shown by citations like the following.*

*Hibbertia* has two Madagascar species.

*Keraudrenia* has one species in Madagascar; it is allied to a Queensland one.

*Zygophyllum.* Australia and the Cape are the headquarters of this genus, which is well represented in the desert.

*Aizoon*, essentially an African genus, is represented in the desert by a species nearly allied to one from South Africa, and the same remark applies to *Mesembryanthemum.*

*Helipterum* is an Australian and South African genus.

*Brachycome* has one species in South Africa.

*Athrixia* is common to Australia, Madagascar, and South Africa.

*Cryptostemma calendulacea* is an introduced South African plant.

*Anguillaria* is a genus closely allied to, and by some considered to be rightly merged in, the South African *Wurmbsea.*

*Cæsia* is a small African and Australian genus.

*Scirpus cartilagineus* occurs also in South Africa [and New Zealand]; *Scirpus cernuus* is an extratropical World form; while *Sporobolus virginicus* and *Anthistiria ciliata* are grasses of wide distribution, including Africa in their range.

### C. *Connection with Eastern Asia and Japan.*

This connection is but slight, as, exclusive of world-wide species or species of generally wide distribution, I find only

*Hypericum japonicum* and *Gnaphalium japonicum* common to temperate Eastern Asia and the desert; it may be added that both species extend into New Zealand. A slight connection is also shown by the genus *Lepidosperma*, which has one South Chinese species, and by *Centrolepis*, with one species from Cambodia.

### D. *Connection with the Mediterranean Region.*

The following short list of species, and to it must be added a few introduced plants and some world-wide forms, shows how little the desert has in common with the Mediterranean region:—*Lepidium ruderale, Alyssum linifolium, Lavatera plebeia* (near *L. arborea*), *Nitraria Schoberi, Echinospermum concavum, Orobanche cernua.* With the exception of *Lavatera plebeia,* all these have a wide range of distribution.

### E. *Connection with New Zealand.*

The following species are common to the desert and New Zealand:—

*Hypericum japonicum, Tillæa verticillaris, Tetragonia expansa, Senecio lautus, Gnaphalium luteo-album, Gnaphalium japonicum, Wahlenbergia gracilis, Thelymitra longifolia, Lemna gibba, Juncus bufonius, Scirpus cartilagineus, Bromus arenarius, Deyeuxia Forsteri, Agropyrum scabrum*, and the ferns *Notholæna distans. Cheilanthes Sieberi, Gymnogramme Pozoi,* and *Gymnogramme leptophylla.* But of these *Lemna gibba* alone is restricted in Australia to the Western Colony, though in all probability it will sooner or later be found in the other Colonies. All the above have a wide extra-Australian distribution, and, with the exception just noted, are also well diffused through Australia.

### F. *Connection with South Georgia.*

It would be travelling beyond the scope of this essay were an attempt made to trace the relations between the desert flora and that of all Antarctic lands. We may, however, take the flora of South Georgia* as a type. Of the 11 genera in Professor Engler's list, not one of the 3 of exclusively or predominantly southern distribution (*Colobanthus, Acæna, Rostkovia*) is represented in the desert. Of the rest, only *Juncus, Festuca,* and *Poa* are desert genera, and none of the species are common to the two regions.

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* Engler in Bot. Jahrbücher, Bd. vii. p. 281.

## REMARKS ON THE RELATIONSHIP OF THE GENERA AND SPECIES OF CERTAIN ORDERS COMPOSING THE DESERT FLORA.*

The following orders have been selected by way of comparison primarily between the Desert flora and that of the moister South-west part of Western Australia.

*Dilleniaceæ.*

Only 4 out of 46 of the S.W. species of *Hibbertia* (as understood by Mueller) reach the desert; all 4 are found south of lat. 30° alone, and none advance eastward of the West Australian boundary. The other genera (*i. e.*, those, exclusive of *Candollea*, *Adrastea*, and *Pachyneura*, which are combined by Mueller with *Hibbertia*) are Euronotian and have no representative in the desert.

*Rutaceæ.*

60 species ranged under 7 genera are known to occur in West Australia: 5 of these genera have between them only 6 desert representatives. All the desert genera, except *Geigera*, are represented in West Australia as fully as, or more so than, in any other part of Australia. Moreover, all the desert species occur also in the South-west corner, and two of them extend into the South-east.

*Leguminosæ*, tribe *Podalyrieæ*.

Of this tribe West Australia has 245 species referred by Mueller to 19 genera: 12 of these genera are represented in the desert by 37 species, and no less than 15 of the latter are endemic in the desert, while of the remainder 18 are shared between the desert and the South-west corner.

*Halorageæ.*

Of the 3 West Australian genera 2 are denizens of the desert. *Haloragis* with 27 South-western species, most of which do not pass over into the South-east, has 5 desert species, but 1 only of them is exclusively South-western; 2 are endemic in the desert, and the 2 remaining reach into South Australia. 2 out of the 3 known species of *Loudonia* are found in the South-west; both of these occur in the desert, and one is restrictedly South-western.

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* The statistics in this section are compiled largely from Mueller's 'Second Census.

*Umbelliferæ.*

This is an order but poorly represented in the desert by 10 species referred to 6 genera. Western Australia has 8 genera, containing between them 52 species. Of the desert species 5 are restrictedly South-western, and 1 extends from the South-west into South Australia south of 30°; 1 is extratropical Australian, including the South-west; 2 are endemic in the desert; while the 10th, known only from the northern and eastern outskirts of the desert, is an extratropical Australian species not found in the South-west corner.

*Compositæ.*

There are 47 genera of Compositæ in Western Australia and 211 species. Of these genera 32 have desert representatives, to the number of 97 in all, but only 12 of the species are endemic in the desert; while, strangely enough, no more than 11 are restrictedly West Australian forms. 35 of the remainder are extratropical or tropical and extratropical Australian including the South-west; 14 have the same distribution, except that they are absent from the South-west; 12 range from the South-west into South Australia; 4 are West and South Australian desert species, 1 of them extending into Western New South Wales; and 5 range from the West Australian desert into the Larapintine region of South Australia, one of them (*Pluchea dentex*) reaching Queensland. The remainder are introductions or species of world-wide distribution.

*Stylideæ.*

This predominantly South-western order is poorly represented in the desert. The two West Australian genera have in all 70 species. Both genera occur in the desert: 1 (*Levenhookia*) represented by a single, the other (*Stylidium*) by 5 species. All the desert species are South-western, except one which is endemic.

*Goodeniaceæ.*

6 of the 11 genera of this predominantly South-western order are found in the desert, and 42 species as compared with the 130 South-western ones. 11 of the species are endemic; 2 are common to the West and South Australian deserts; 1 is a Larapintine species; 15 are South-western; 2 are tropical and extratropical Australian, including the South-west; 7 are tropical and

extratropical Australian, but excluded from the South-west corner; while 4 are natives of the North-west tropics, whence 2 of them extend into the Larapintine region of South Australia.

*Epacrideæ.*

An order very sparsely represented in the desert. 11 genera (as understood by Mueller), with 152 species between them, are known from the South-west. This number dwindles in the desert to 3 genera and 4 species! One of the 4 is endemic; the rest are South-western forms.

*Loganiaceæ.*

This order is represented in the desert solely by the predominantly West Australian genus *Logania*, of which three species have been met with in the desert, all of them south of 30°. One of these is South-western; the other two range eastward into South Australia, one of them reaching New South Wales and Victoria.

*Solanaceæ.*

7 of the 8 South-western genera of this order inhabit the desert, where they are represented by 18 species—there being 27 West Australian species in all. *Solanum* has 12 desert representatives, as contrasted with only 9 in the South-west. 1 of the 12 is endemic; only 1 is restrictedly West Australian including the South-west; 2 are West and South Australian desert species; 2 are extratropical Australian, including the South-west; and 6, while extratropical Australian, are absent from the South-west corner.

*Myoporineæ.*

This order, which is somewhat better represented in the West Australian than in the other Colonies, appears in strong force in the desert, where all the 3 Australian genera are found and 35 species. Of these no less than 15 are endemic in the desert of West Australia; 1 is restricted to the West and South Australian deserts; 2 are Larapintine; 5 are South-western; 4 extratropical or tropical and extratropical Australian, including the South-west; and 7 the same, but excluding the South-west corner; while one is a North-west tropical species which advances into the desert north of 30° only.

*Amaranthaceæ.*

Fairly well represented in the desert by 4 genera sharing 14 species—the South-west having 47 species referred to 8 genera. 2 of the desert species are endemic; 3 are South-western; 6 are extratropical or tropical and extratropical Australian, 5 including and 1 excluding the South-west; 2 are tropical Australian forms which penetrate into the northern part of the desert; and 1 ranges from the North-west tropics through the northern part of the West Australian desert into the Larapintine region of South Australia.

*Chenopodiaceæ.*

In the South-west there are 12 genera, according to Mueller's classification, and 61 species. 8 of these genera, with 31 species, are found in the desert. Only 2 of the species are endemic in the West Australian desert, 2 more are restricted to the deserts of West and South Australia, and 1 species is Larapintine; 14 are extratropical or tropical and extratropical Australian, including the South-west; and 8 have the same distribution, except that they are not known from the South-west corner. *Salsola Kali* has world-wide distribution.

*Loranthaceæ.*

All the South-western species of *Loranthus* reach the desert, there being only 5 South-western and North-west tropical species altogether, whereas 8 species are now known from the desert. One species is endemic in the West Australian desert, and two are shared between it and the desert of South Australia, while a third extends into the West Australian desert from the south of South Australia. The 4 remaining are distributed over tropical and extratropical Australia, and all the 4, except 1, are found in the South-west corner.

*Proteaceæ.*

Bearing in mind the richness of this order in the South-west corner of the continent, it is very poorly represented in the desert. From Mueller's Census we learn that there are no less than 397 species of West Australian Proteaceæ, referred to 15 genera, and nearly all of them are exclusively West Australian. 11 of these genera occur in the desert, but only 47 species. 12 of the species are endemic in the West Australian desert; 3 are shared between the West and South Australian deserts, and 1 of the 3 reaches the South-west corner; 28 are South-western species; 2 are extratropical Australian, including the South-west, and as many are extratropical or subtropical Australian, but absent from the South-west corner.

*Euphorbiaceæ.*

West Australia has 13 genera with 51 species. 9 genera and 19 species are found in the desert: of the 19, 4 are endemic and 6 are South-western species; 3 are extratropical Australian, including the South-west; and 6 are similarly distributed, except that they are absent from the South-west corner.

*Casuarineæ.*

Mueller enumerates 15 species as natives of West Australia. There are 8 desert species, and of them 2 are endemic in the desert; 3 are South-west species; 1 is South Australian, and extends into the desert south of 30°; while 2 are tropical and extratropical Australian, excluding the South-west.

*Orchideæ.*

As might be expected, there is in the desert a great falling off in the number of representatives of this order. Only 6 species belonging to 4 genera are reported from the desert, as against 18 genera and 75 species in the South-west; 4 of the desert species are South-western and 2 are extratropical Australian, including the South-west corner, 1 of the 2 reaching Polynesia and New Zealand. The genera represented in the desert are, it may be added, *Thelymitra*, *Pterostylis*, *Diuris*, and *Microtis*, and only the latter is known from that part of it lying north of 30°.

*Hæmadoraceæ.*

3 of the 5 West Australian genera have desert representatives, but only 5 of the 56 South-western species advance into the desert.

*Liliaceæ.*

The 15 desert species (referred to 13 genera) contrast poorly with the 25 genera and 76 species from the moister parts of West Australia. Only 1 of the 15 species is endemic; 7 are South-western species; 6 are extratropical Australian, including the South-west; and 1, while widely distributed over extratropical Australia, is not found in the South-west corner.

*Centrolepidæ.*

The 3 genera and 14 species of the South-west dwindle in the desert to 2 genera, each with a single species. Both the latter are found in the South-west corner.

*Restiaceæ.*

There are 11 genera and 47 species of Restiaceæ in the South-west, but only 2 of the species (referred to 2 genera) advance thence into the desert.

*Cyperaceæ.*

The 5 desert genera and 14 species contrast poorly with the 14 genera and 123 species known from Western Australia as a whole. Of the 14 species 1 is endemic and 6 are South-western; while 7 are distributed over extratropical Australia, 3 of them not reaching the South-west corner.

*Gramineæ.*

West Australia has 38 genera of grasses and 115 species; in the desert there are, exclusive of *Briza maxima*, 24 genera and 41 species. No species is restricted to the West Australian desert, but 3 are West and South Australian desert grasses. Moreover, 3 only are South-west species, while 23 are extratropical Australian, including the South-west. The 12 remaining are extratropical Australian species which do not reach the South-west corner.

*Filices.*

Only 6 genera showing 11 species (according to Mueller's estimate) are natives of West Australia. From the desert 6 species are known belonging to 2 genera. Of the 6, 5 are widely distributed in Australia, while 1 is a Larapintine species reported from the West Australian desert only close to its eastern boundary.

The majority of the orders just mentioned are either predominantly South-western, or they are orders represented in the desert by genera predominantly or at least strongly represented in the South-west corner. This remark applies specially to the following:—Dilleniaceæ, Rutaceæ, Leguminosæ, Podalyrieæ, Halorageæ, Umbelliferæ, Stylideæ, Goodeniaceæ, Loganiaceæ, Epacrideæ, Amaranthaceæ, Proteaceæ, Euphorbiaceæ, Hæmodoraceæ, Liliaceæ, Centrolepidæ, and Cyperaceæ. The following are worthy of special notice.

*Compositæ.*

Half the desert species are distributed through Australia, but of these rather less than $\frac{1}{3}$ are not found in the South-west corner. Only $\frac{1}{8}$ are South-western species which penetrate into the desert but do not range beyond it.

*Solanaceæ.*

The desert species of *Solanum* outnumber those in the South-west, and only $\frac{1}{4}$ of these occur also in the South-west, while $\frac{2}{3}$ are known from the Eastern Colonies.

*Myoporineæ.*

$\frac{3}{7}$ of the species are restricted to the desert, a remarkably high proportion; while if we include species confined to the deserts of South and West Australia, $\frac{1}{2}$ the Myoporineous flora is endemic. Only $\frac{1}{4}$ of the desert species occur in the South-west, while nearly $\frac{1}{3}$ are known from the Eastern Colonies.

*Epacrideæ.*

The dwindling of this order in the desert is very remarkable, it being represented there only by between 2 and 3 per cent. of species advancing from the South-west.

*Loranthaceæ.*

Noteworthy as being better represented in the desert than in the South-west. $\frac{1}{2}$ the desert species are found in the Eastern Colonies, and $\frac{3}{8}$ in the South-west.

*Casuarineæ.*

There are more than $\frac{1}{2}$ as many desert as South-western species; $\frac{3}{8}$ are South-western, and as many are found in one or more of the Eastern Colonies, but not in the South-west corner.

*Orchideæ.*

Only 8 per cent. of South-western species occur in the desert.

*Restiaceæ.*

This order falls off greatly in the desert, the percentage of desert to South-western species being between 4 and 5 only.

*Gramineæ.*

This order is noticeable for the small number of South-western species which advance into the desert and do not penetrate east of it, less than $\frac{1}{14}$ of the grass-flora consisting of such species.

### GENERAL CONCLUSIONS RESPECTING THE DESERT FLORA.

From the table on p. 240 we learn that of the 849 phanerogamous species—exclusive of introductions—composing the flora of the West Australian desert, 537, or 63·2 per cent., occur in the South-west corner, while 371, or 43·7 per cent., are met with in the Eastern Colonies. Moreover, while of the 537 South-western species, 276 are not known from the Eastern Colonies, except that 43 of them extend into South Australia, of the 371 Eastern species only 100 are not found in the South-west. Viewing the flora as a whole, then, it would seem to consist of two elements—a main one, derived from the South-west, and a subsidiary one, passing in from the East. To this must be added an endemic element, amounting as we have seen to 146 species, or 17 per cent. Doubtless this is only a rough method of stating the case, for it may well be that some of the species restricted to the desert and the South-west may have originated in the desert and migrated thence; and the remark applies with equal force to some of the Eastern species which do not penetrate beyond the desert into the South-west corner. It is, however, difficult to understand why a species should have migrated from the desert in one direction rather than in the other; and inasmuch as the chances of extension in either direction would be approximately equal, the statement given above probably represents the real facts.

The orders best represented in the desert are, *Compositæ*: with 97 species (11 per cent.); *Leguminosæ*, with one less; and *Myrtaceæ*, with 89 species (rather more than 10 per cent.); and between them these monopolize the flora to the extent of nearly ⅓. In the second flight, with 35 species and over, are five orders: *Amaranthaceæ* and *Proteaceæ*, each with 47 species (rather more than 5 per cent.); *Goodeniaceæ*, with 42 species (5 per cent.); *Gramineæ*, with 41 species, and *Myoporineæ* with 35 species (4 per cent.). These 8 orders have 494 desert representatives, or nearly 58 per cent. of the whole flora. The remaining 42 per cent. is thus shared between no less than 65 orders.

The prevalence of Compositæ, and the relatively large number of its desert species with a wide range of distribution through the island-continent—these facts are doubtless due to the pappus with which the achenes of these plants are provided. The statement of the late Mr. Bentham* with reference to the comparative worthlessness of the pappus does not apply to a country where rain and dew, which in moister climates so rapidly cause the pappus to collapse, are of but rare occurrence, where wind-storms frequently prevail, and gentle breezes, sufficient to waft the downy plumes over considerable distances, are constantly recurring. Absence of the insects necessary for pollination is probably the reason for the extreme scarcity of species belonging to orders such as the Epacrideæ, Stylideæ, and (to a certain extent) Proteaceæ—scarcity one would hardly have ventured to predict in view of the relative abundance of allied plants in the South-west. The flowers of the relatively abundant Luguminosæ and Myrtaceæ are, I believe, to a large extent wind-fertilized. In fact, after paying considerable attention to the subject, I came to the conclusion that self-fertilization almost always obtains in the desert. I noticed, indeed, that the flowers of various species of *Acacia*, as also those of *Scævola spinescens*, were visited by the small butterfly *Catachrysops biocellata*, Feld., in some numbers, and the flowers of the latter were also attractive to the handsome *Delias aganippe*†, Donov. On only one other occasion did I notice insects on flowers. That was at Gnarlbine, close to permanent water, and here the cloyingly sweet spikes of *Grevillea nematophylla* had attracted quite a number of winged visitors. True, ants are abundant, and stragglers from their ranks may occasionally be discovered within corollas, though these are by no means effectual pollinating agents. But although the frequency of insects' visits may be a matter of great importance to herbs with flowers adapted to entomophily, and although shrubs and trees with such flowers will stand a better chance of distribution in space the more bountiful the supply of insect-life in the districts inhabited by them, yet insects are not of such moment to shrubs and trees—and shrubs and trees especially abound in the desert—because of their perennial habit, and their more complete exposure to winds, which, by agitating their branches, shake the pollen out of the anthers and give it a chance of reaching its destination. A shrub and a tree might thus be enabled to slowly extend its area if the necessary crossing were effected by very rare visits from insects; and this at most is, I think, all that can obtain in the desert, at least in places removed from a permanent supply of water. Coleoptera, it may be added, are more abundant in the desert than are other insects, nearly 200 having been secured by the Elder Expedition *; but I doubt whether many of these insects visit flowers—at least, except for the case at Gnarlbine already mentioned, I do not remember to have seen one upon a flower.

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* Journ. Linn. Soc., Bot. vol. xiii. (1873) p. 573.

† Messrs. Butler and Kirby kindly gave me these determinations. I also secured two or three specimens of *Junonia vellida*, Fabr., a species which settles on the ground, never, so far as I saw, on flowers. Besides the above I did not see more than two others, and these I failed to secure. Curiously enough, not one of my three species figures in the list of Lepidoptera brought down by the Elder Expedition.

The comparative abundance of Loranthaceæ in the desert has been already mentioned; one has not to go far in search of a cause for this. These parasites obtain all the water they need from their hosts, and, provided that the latter can maintain their existence, the parasite is safe. The seeds are probably diffused by the few frugivorous birds that haunt the desert solitudes. In Brazil I was struck by the extent of the ravages inflicted by these parasites upon their hosts. I saw no signs of such destruction in Australia: indeed, their usually small and leathery or woolly leaves are evidently adapted to keep down transpiration, and thus to reduce to a minimum the injury they inflict upon the plants which support them.

It has already been mentioned that in the desert shrubs and trees predominate over herbs; indeed, no less than 538 of the 849 indigenous species have one or the other habit. Moreover, a considerable proportion of the 311 herbs are perennials provided with woody rootstalks, so as in their habit to approach undershrubs. Annuals enjoy but a precarious existence during the cool weather of early spring; probably some years are more favourable to them than others, at least I infer this from their greater abundance during the first spring I was in the country.

## XEROPHILY.

Adaptation to drought is shown in many ways by the plants of the West Australian desert, and I propose here briefly to reca-

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* Many of these, however, came from South Australia. The fauna as a whole may be described as mainly Lacertilian and Coleopterous (*vide* Elder Expedition Report).

pitulate the chief of these adaptations, adding a few examples of each by way of illustration.

(*a*) Diminution of the transpiring surface.

*Hibbertia glomerata*, *Tetratheca efoliata*, *Mirbelia* spp., *Jacksonia spinosa*, *Daviesia brevifolia*, *Cassia* spp., *Loudonia aurea* and *Roei*, Myrtaceæ Chamælaucieæ, *Grevillea* spp., *Hakea* spp., *Exocarpus spartea*.

(*b*) Spines and thorns.

Spiny plants are remarkably few in number, and in most cases the armature is not very prominent. Some examples are:

*Bursaria spinosa* (this also occurs with spines along the moist Australian littoral), *Gastrolobium calycinum* and *G. spinosum*, *Mirbelia microphylla* and *M. microphylloides*, *Jacksonia spinosa*, *Acacia erinacea*, *Cryptandra petræa*, *Scævola spinescens*, *Solanum* spp. (thorns).

(*c*) Aphylly.

This also is not so common as might be supposed; as instances may be cited:

*Tetratheca Harperi*, *Brachysema Chambersii* and *B. daviesioides*, *Daviesia aphylla*, *Templetonia egena*, *Spartothamnus teucriiflorus*, *Exocarpus aphylla*, *Casuarina* spp.

(*d*) Phyllodes or leaves oriented in the manner of phyllodes.

*Gastrolobium bilobum*, *Phyllota lycopodioides* and other Leguminosæ Podalyrieæ, *Acacia* spp., *Eucalyptus* spp., *Astroloma Candolleanum*, *Persoonia Leucopogon*, *Lysinema ciliatum*, *Grevillea*, spp.

(*e*) A thick tomentum.

*Sida* spp., *Hibiscus Krichauffianus*, *Keraudrenia integrifolia*, *Rulingia coacta* and other spp., *Swainsona* spp., *Psoralea eriantha*, *Gnephosis* spp., *Angianthus tomentosus*, *Gnaphalodes* spp., *Solanum* spp., Verbenaceæ, Chloantheæ, *Loranthus gibberulus* and *L. Nestor*.

(*f*) Leaf-surface reduced, the leaves being of the rad type.

*Dodonæa filifolia* and *D. stenozyga*, *Verticordia* spp., *Calythrix* spp., *Thryptomene* spp., *Melaleuca uncinata* &c., *Grevillea nematophylla* &c., *Hakea lorea*.

(*g*) Coriaceous leaves.

*Gastrolobium* spp. and other Leguminosæ Podalyrieæ, *Canthium* spp., *Alyxia buxifolia*, Proteaceæ.

(*h*) Fleshy leaves.

*Calandrinia* spp., *Zygophyllum* spp., *Tillæa verticillaris*, *Baeckia crassifolia*, *Tetragonia expansa*, *Mesembryanthemum australe*, *Trianthema crystallina*, *Atriplex* spp., *Rhagodia crassifolia*, *Kochia* spp., *Salicornia* spp., *Salsola Kali*.

(*i*) Glands secreting essential oils.

*Boronia cærulescens*, *Eriostemon nodiflorus*, *Phebalium tuberculosum* and other Rutaceæ, Myrtaceæ Chamælaucieæ, *Eucalyptus* spp.

(*k*) A viscid secretion.

*Dodonæa* spp., *Gompholobium viscidulum*, *Acacia* spp., *Pholidia saligna*, *Eremophila Fraseri*, *Beyeria viscosa*.

(*l*) Cell-sap containing a relatively large percentage of saline matter.

*Tetragonia expansa*, Chenopodiaceæ.

(*m*) A thick coating to fruits.

*Melaleuca*, *Eucalyptus*, *Eremophila*, *Pholidia*, Proteaceæ, *Casuarina*, *Callitris verrucosa*.

(*n*) Papery involucral scales or perianth.

Species of *Helichrysum*, *Helipterum* and other Compositæ, *Ptilotus*, *Trichinium*.

(*o*) Water-reservoirs in root or stem or both root and stem.

*Sterculia diversifolia*, *Eucalyptus* spp.

(*p*) Stomata in pits.

Proteaceæ, *Casuarina*.

## DESERT PLANTS PROVIDED WITH MEANS OF DIFFUSION BY THE AGENCY OF ANIMALS.

The fauna of the desert being such a poor one, one would naturally expect to find that few of its plants enjoy any provision for diffusion of their fruits and seeds by means of animals. The list here given is, it is believed, almost exhaustive. It may be thus summed up:—

| | |
|---|---|
| Burred fruits | 10 |
| Adhesive ,, | 1 |
| Fleshy ,, | 42 |
| Succulent seeds | 1 |

The 10 plants with burred fruits are:—*Tribulus terrestris*, *Daucus brachiatus*, *Trachymene cærulea*, *Calotis erinacea*, *C. plumulifera* and *C. hispidula*, *Echinospermum concavum*, *Sclerolæna bicornis* and *S. diacantha*, *Salsola Kali*.

All the above, except *Trachymene cærulea*, which is restricted to Western Australia, and *Sclerolæna bicornis*, absent from the South-west, are widely distributed through the island-continent.

The common tropical weed *Polanisia viscosa* is, I believe, the only desert plant provided with adhesive fruits.

The fleshy-fruited species are:—

*Sollya heterophylla*, *Scævola spinescens*, *Jasminum calcareum*, *Alyxia buxifolia*, *Solanum* (12 spp.), *Duboisia Hopwoodi*, *Rhagodia* (3 spp.), *Muehlenbeckia adpressa*, *Pimelea* (9 spp.), *Cassytha* (2 spp.), *Loranthus* (5 spp.), *Exocarpus* (2 spp.), *Anthobolus exocarpoides*, *Santalum lanceolatum*, and *Fusanus persicarius*. With the exception of the *Sollya*, the Jasmine, half the *Solanums*, and 7 of the *Pimeleas*, all the above are more or less widely distributed over Australia.

*Pittosporum phyllyreoides*, well diffused over Australia, is the plant with seeds immersed in a succulent pulp.

It should be noted, however, that in few only of these cases is the fleshiness at all marked.

## HOMOPLASY.

*Pholidia gibbifolia*, F. Muell., is a very singular plant, and, as might be seen on examination of the plates accompanying Mueller's fine monograph of the Myoporineæ, quite unlike any other *Pholidia* previously described. The chief peculiarity resides in the leaves, which are much reduced, appressed to the stem, and curiously tuberculated. Had the specimens described by me in this memoir as *Pholidia homoplastica* not been in flower when they were gathered, I should have concluded, without hesitation, that they must be referred to Mueller's species; for in habit, as in leaf, the two seem absolute counterparts. The flowers, however, are quite different, and, indeed, a more extraordinary resemblance in vegetative characters, resemblance not involving any protective function, has never come under my notice. Another of the new Myoporineæ, *Pholidia saligna*, is treacherously like *Myoporum platycarpum*, R. Br., except as regards the floral characters.

The frequent close resemblance between certain species of *Loranthus* and their hosts was also noticed by me; nor was it without interest that I learnt, on my return home, how the same fact had been alluded to by that sagacious observer, James Drummond *, more than half a century ago. The two species showing this resemblance best are *Loranthus pendulus*, Sieb., var. *parviflora*, which is difficult to descry when growing upon the Quandong, and *L. Quandang*, Ldl., of which the leaves are strikingly similar to those of its host, an *Acacia*. But it may be doubted whether mere homoplasy is in point here, seeing that the parasites are greedily eaten by camels †, and so are, in all probability, equally attractive to vegetivorous marsupials. In these cases, therefore, the resemblance may possibly be protective, and may have been perfected by means of natural selection. The attraction probably lies in the flowers, which contain much nectar and are very sweet in consequence.

It may also be mentioned that some Proteaceæ, Grevilleas and Hakeas especially, can scarcely be distinguished from Acacias when not in flower or fruit.

## The Distribution of Desert Plants in Relation to the Soil.

Allusion has already been made to the prevalence of Myrtaceæ in certain districts between Southern Cross and Siberia; and I propose now to describe briefly the peculiar flora found in the immediate neighbourhood of the large granite outcrops known as gnamma-rocks. The red soil, so common elsewhere, here gives place to soil of a pale-yellow colour, and this change is invariably accompanied by a change in the flora.

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* Hooker's Journal of Botany, ii. (1840) pp. 347 & 360.

† Camels will browse upon the parasites and leave the hosts quite untouched, although the latter are themselves excellent food. There would be stronger support for the suggested mimicry were the host distasteful; but the parasites have, it must be remembered, only a small range of selection, if any.

The exclusively gnamma-rock plants observed by me are the following:—

*Keraudrenia integrifolia*, *Stackhousia* spp., *Cryptandra petræa*, *Oxylobium graniticum*, *Mirbelia microphylloides*, *Drosera* spp., *Kunzea sericea*, *Podolepis pallida*, *Helichrysum semipapposum*, *Helipterum Manglesii*, *Goodenia hederacea*, *Dampiera lavandulacea*, *Isotoma petræa*, *Solanum lasiophyllum*, *Eremophila granitica*, *Prostanthera Baxteri*, *Grevillea nematophylla*, *Hakea suberea*, *Parietaria debilis*, *Thelymitra longifolia* and *T. antennifera*, *Pterostylis pyramidalis*, *Borya nitida*, *Juncus bufonius*, *Centrolepis mutica*, *Scirpus cartilagineus* and *S. cernuus*, *Notholæna distans*, *Gymnogramme Pozoi*.

The presence at the rocks of many of the herbs in this list, especially the Droseras, the Orchids, *Parietaria debilis*, the Cyperaceæ, and the Ferns, is undoubtedly due in part to the fact that the places where they have managed to establish themselves are specially favoured by their position, and are enabled to retain moisture longer than other spots; in the case of ferns, too, shade as well as moisture is essential. One finds such plants, therefore, only in crannies between the rocks, or on level spaces abutting upon a sloping rock-face down which the water pours during a storm. But this explanation will not suffice for *Hakea suberea* which is a tree, nor for such large shrubs with long roots as the *Keraudrenia*, the *Oxylobium*, *Kunzea sericea*, *Eremophila granitica*, and *Grevillea nematophylla*. Why, too, should we find such lowly herbs as *Podolepis pallida* and *Helichrysum semipapposum* near gnamma-rocks, it may be weeks after rain has fallen and all surface-water has drained away, while on red soil not more dry, their place is taken by *Helipterum Fitzgibboni* and *rubellum*, *Schœnia Cassiniana* and *Cephalipterum Drummondii*? I know of low-lying spots between Coolgardie and Gibraltar where rain-water lies for some time, and where in the spring there is a perfect carpet of flowering herbs, yet not one of them is identical with a gnamma-rock species. Professor Tate* met with a somewhat similar rock-flora in Central Australia; but I cannot agree with him in thinking these plants to be representatives of an ancient flora driven, by gradually increasing drought, to take refuge among the rocks for the sake of the supposed larger amount of surface water to be found there, though in a few cases, as already mentioned, proximity to the rocks is a great advantage. Moreover, it seems impossible, on Professor Tate's view, to explain why all the ground near rocks is not densely clothed with vegetation. One would think that, in a country where the rainfall is so small, and where, for all their adaptability to resist the effects of drought, plants undoubtedly suffer during long dry intervals, there would be, as it were, a general movement towards places where injury from this cause would be reduced to a minimum. This is, however, not the case: indeed, the neighbourhood of the rocks is almost always remarkably bare, and far more so than the surrounding country. The facts are only to be explained on the supposition that the red soil contains ingredients which are unsuited to the rock plants, while the granitic soil is not favourable to plants which flourish in red soil.

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* 'Botany of the Horn Expedition,' p. 120.

The prevalence of Myrtaceæ on stretches of pale soil where there are no outcropping rocks has already been mentioned. Directly one arrives at such a stretch of country, the gum-trees drop off and disappear entirely or almost so, and are replaced by shrubs, usually Myrtaceous. Singular as it may seem, I do not remember to have met with one of these Myrtaceæ near a gnamma-rock, and the only explanation one can find for this is that there is a third kind of soil specially suited to this Myrtaceous vegetation. The change in the flora is often very striking; thus I recall one place, between Coolgardie and Gibraltar, where the thickly growing Myrtaceæ ended quite suddenly and stood like a battalion of troops drawn up on parade, and they were visible in this order for a long distance.

To a few species the nature of the soil seems immaterial. I have noted *Sterculia diversifolia*, *Pholidia scoparia*, *Phebalium tuberculosum*, *Scævola spinescens*, *Trichinium obovatum*, and certain grasses as flourishing near gnamma-rocks and also in red soil, without any special preference for either situation.

# On the Production of Apospory by Environment in *Athyrium Filix-fœmina*, var. *unco-glomeratum*, an apparently barren Fern. By F. W. Stansfield, M.B. (Communicated by C. T. Druery, F.L.S.)

[Read 2nd February, 1899.]

The form of lady-fern which is the subject of the present paper is of such a remarkable character that it will be well to give its history; and fortunately this can be done in very few words. Its pedigree commences with *A. Filix-fœmina*, var. *acrocladon*, an extremely ramose, or, as fern-fanciers would say, a *ramosissimum* form, which was found wild in Yorkshire in 1860 by Mr. C. Monkman. Until about 1877 *acrocladon* was supposed to be a barren fern, and was propagated only by division. In 1877 my brother and I noticed spores upon a plant of it, and these were carefully collected and sown. From this sowing there resulted, in the following year, a fair crop of plants, of which about one-third were true *acrocladon*. The remaining two-thirds were mostly weeds—*i. e.* irregular forms, worthless from the decorative point of view. There were two plants, however, which were considered to be advances upon *acrocladon* in the matter of extreme development. One of them was *A. Filix-fœmina*, var. *unco-glomeratum*, so named by the late Colonel A. M. Jones because, along with the glomerate character of *acrocladon*, it possessed the peculiar subdivision of parts which is characteristic of the variety *uncum* of Barnes. Whether it was the result of a cross between *uncum* and *acrocladon* it is impossible to say, but it is not improbable that this was the case, inasmuch as the parent *acrocladon* was growing in a house with a large number of other ferns; and under these circumstances (or, indeed, under almost any circumstances) it is impossible to exclude stray spores of other ferns which may settle upon the spore-bearer.

*A. Filix-fœmina*, var. *unco-glomeratum* proved to be a very beautiful form, but exceedingly refractory in the hands of the propagator. During nearly twenty years only some three or four divisions were obtained, and two years ago there is reason to believe that only two or three plants were in existence. The plant had shown in my hands no tendency to produce spores or bulbils, nor did there seem the slightest reason to suppose that it was capable of apospory. All its vital energy seemed to be expended in branching and subdividing, so that a frond consisted of a solid mass of ramifications ending in myriads of minute green points.

Matters were at this pass when in October 1896, as the plant in my garden was dying down for the winter, I noticed that, in the case of one or two immature fronds, although the greater part of the frond was turning brown, the extreme tips were still green and formed little knots of living tissue each about the size of a pin's head. It occurred to me that if these could be kept alive until the spring they might develop into bulbils, and so form independent plants. Under the influence of this idea, on November 5th, 1896, I laid down in a pot a portion of a decaying frond with the green bud-like bodies attached, the latter being brought into contact with the soil, and the whole covered closely with a bell-glass.

I quote now from my journal the notes made at various stages of the culture :—

*Dec.* 1, 1896.—The bud-like bodies are evidently the undeveloped parts of the frond to which they belonged. They are beginning to unroll, and look green and healthy.

*Feb.* 5, 1897.—Development has been going on slowly all through the winter. The growths are branching and continuing to unroll. They look like bits of frond still only partially developed.

*June* 6, 1897.—The pieces are now luxuriant and healthy-looking masses of branches, each about ½ to ¾ of an inch in diameter; they are still growing, but there are no roots nor root-hairs visible, nor any bulbils or new axes of growth. It has been, so far, a process of continued unrolling.

*Nov.* 5, 1897.—The basal parts of the pieces of frond are beginning to decay. The tips are still alive and green, and continue to expand, but this process has apparently nearly reached its limit. The tips are thin and pellucid, and have a semi-prothalloid appearance. There are no buds nor root-hairs to be seen.

*March* 1, 1898.—The cultures have been almost at a standstill during the winter. Only the extreme tips of the growths are now alive, though the bunches of frond are still discernible in a half-decayed condition.

*April* 30, 1898.—Several of the pieces have died altogether.

One or two of the tips of those still living are expanding laterally, and have a distinctly prothalloid appearance. Two or three other tips have run out from the rhachides into long slender ribbon-like processes which branch dichotomously though at longer intervals than in *unco-glomeratum.*

*May* 5, 1898.—One of the tips has assumed the character of a definite prothallus. It has increased considerably in size, being now about $\frac{1}{8}$ of an inch in diameter, and root-hairs are visible upon both its upper and lower surfaces. A tiny bud, I think, can be perceived at the bifurcation of one of the ribbon-like processes noted April 30.

*June* 1.—The largest prothallus has a bud upon its upper surface near the sinus, but not proceeding from it.

*June* 3.—A tiny frond is emerging at the sinus from the underside of the prothallus. The bud on the upper surface is more distinct and shows white silvery scales.

Fig. 1.

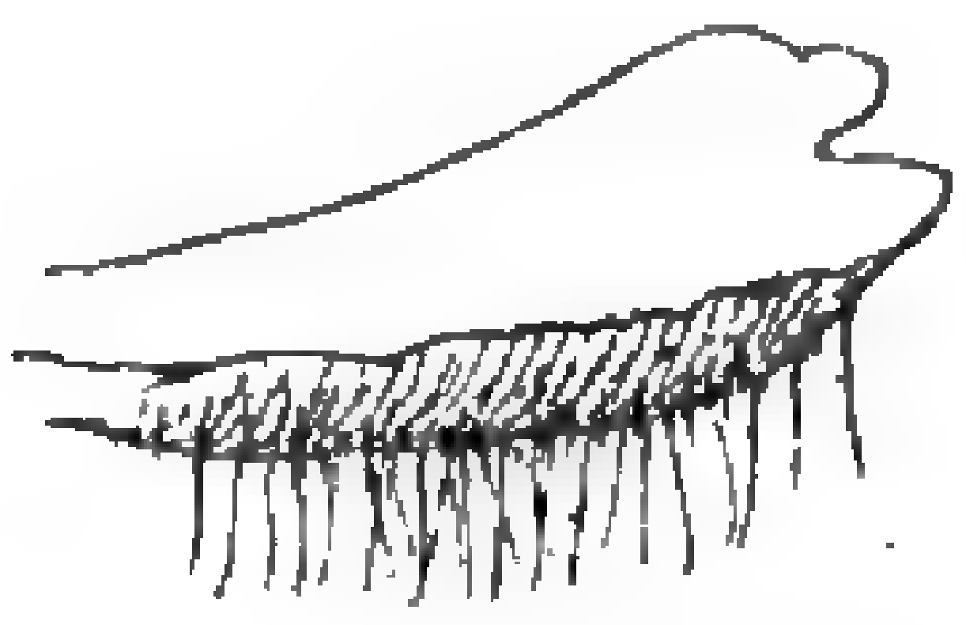

Fig. 2.

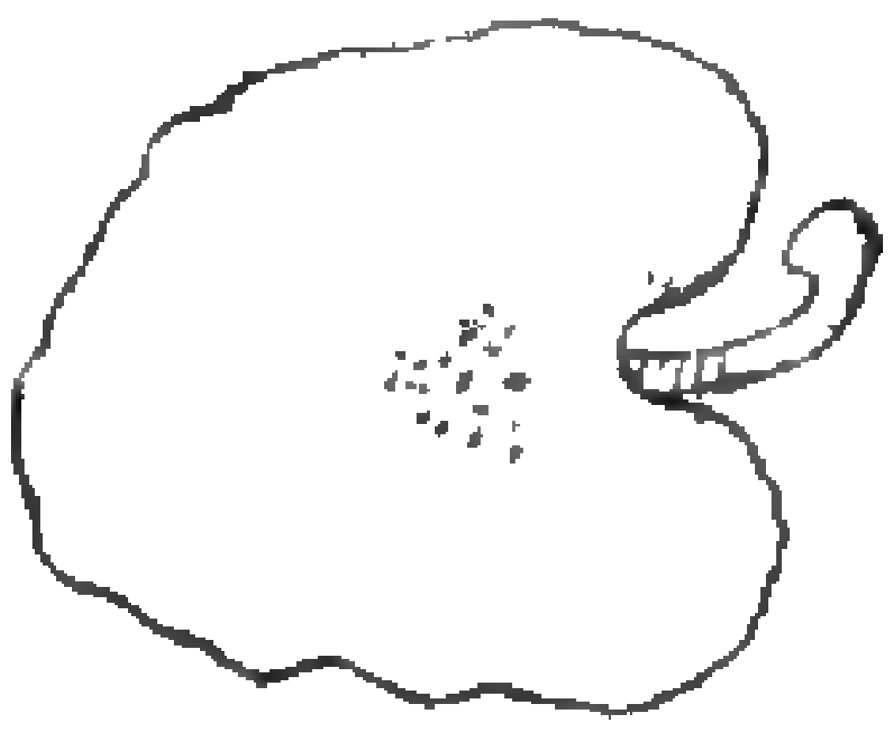

Fig. 1.—Side view of prothallus developed from extreme tip of pinnule. May 5.

Fig. 2.—Development of prothallus. June 3.

*June* 6.—The tiny frond is beginning to branch, being now bifurcate and still unrolling. The bud upon the ribbon-like process, noted May 5, has developed into a ramulose frond characteristic of *unco-glomeratam.* The process from which it sprang is decaying without having produced any prothallus.

*July* 4.—The frond from the sinus of the prothallus is ramulose and characteristic; another is pushing up alongside it. The bud on the upper surface is throwing up two fronds. A curious fleshy translucent process is emerging from the side opposite to the sinus of prothallus No. 1. One or two other prothalli are developing root-hairs; one other prothallus (No. 2) is $\frac{1}{8}$ of an inch in diameter.

*July* 10.—A bud is visible on the upper surface of prothallus No. 2. Two other bulbils have appeared on the growths from the old rhachides; none of these have produced prothalli. At Mr. Druery's suggestion I replanted the old pieces of fronds in order to bring the living tips into contact with the soil.

Fig. 3.

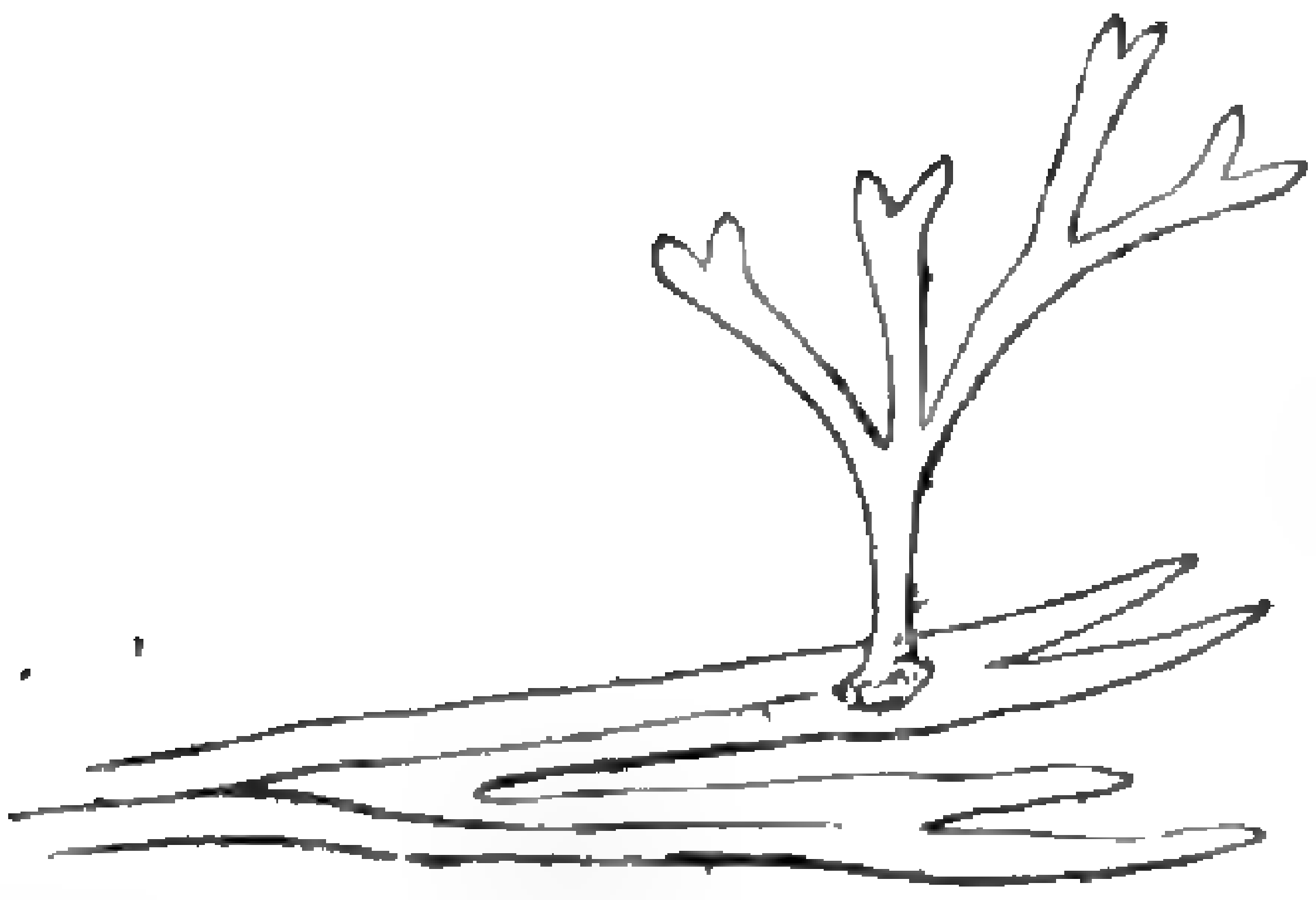

Fig. 5,

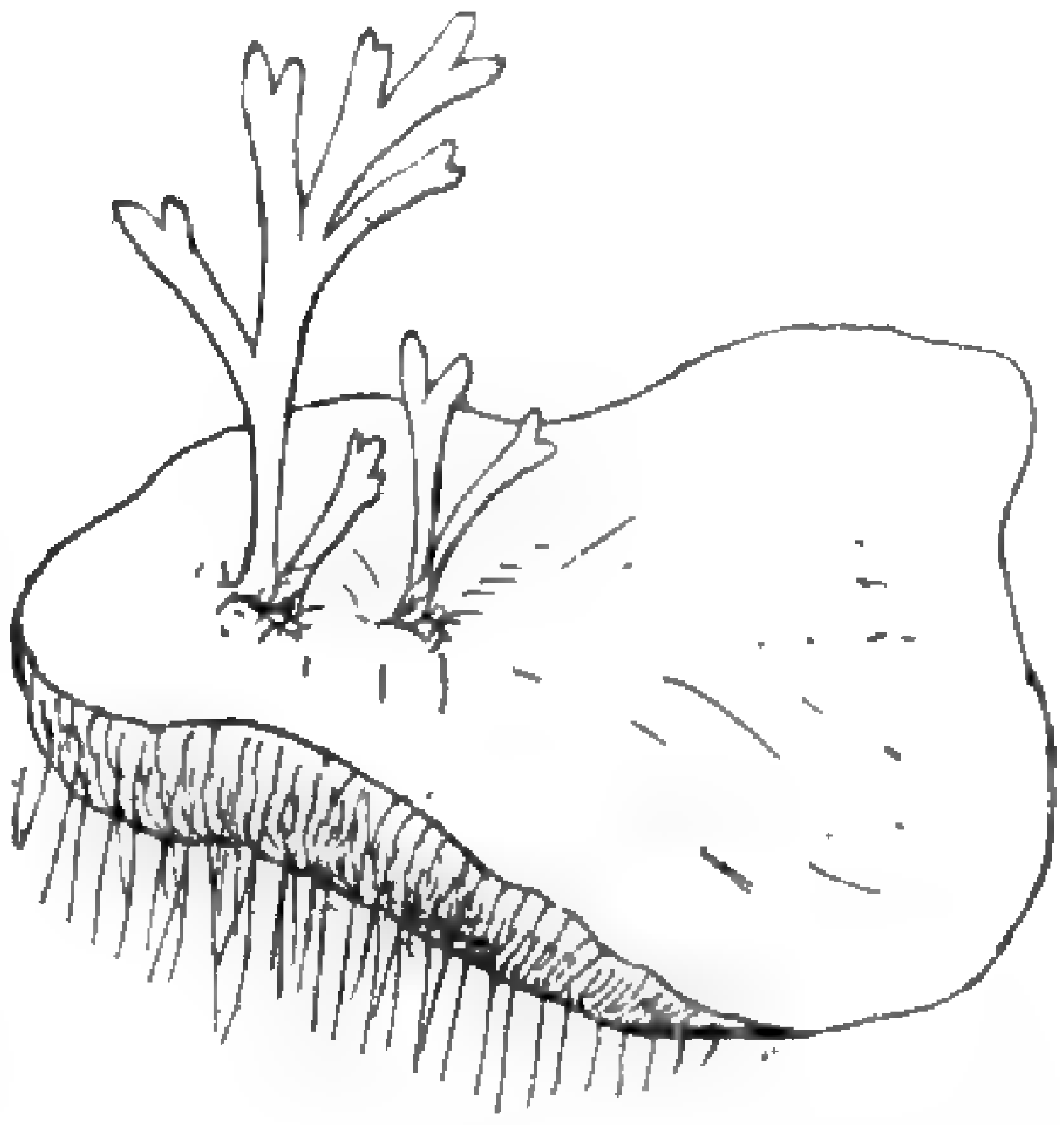

Fig. 3.—Plantlet developed from bulbil on ultimate division of frond.
Fig. 5.—Another prothallus with two asexual buds und subsequent development of same.

*August* 10.—Another bud has appeared, close to the first, on the upper surface of prothallus No. 2; the first bud is sending up a frond. Several other prothalli are developing from the old tips. The fleshy process on prothallus No. 1 is forking near its

Fig. 4.

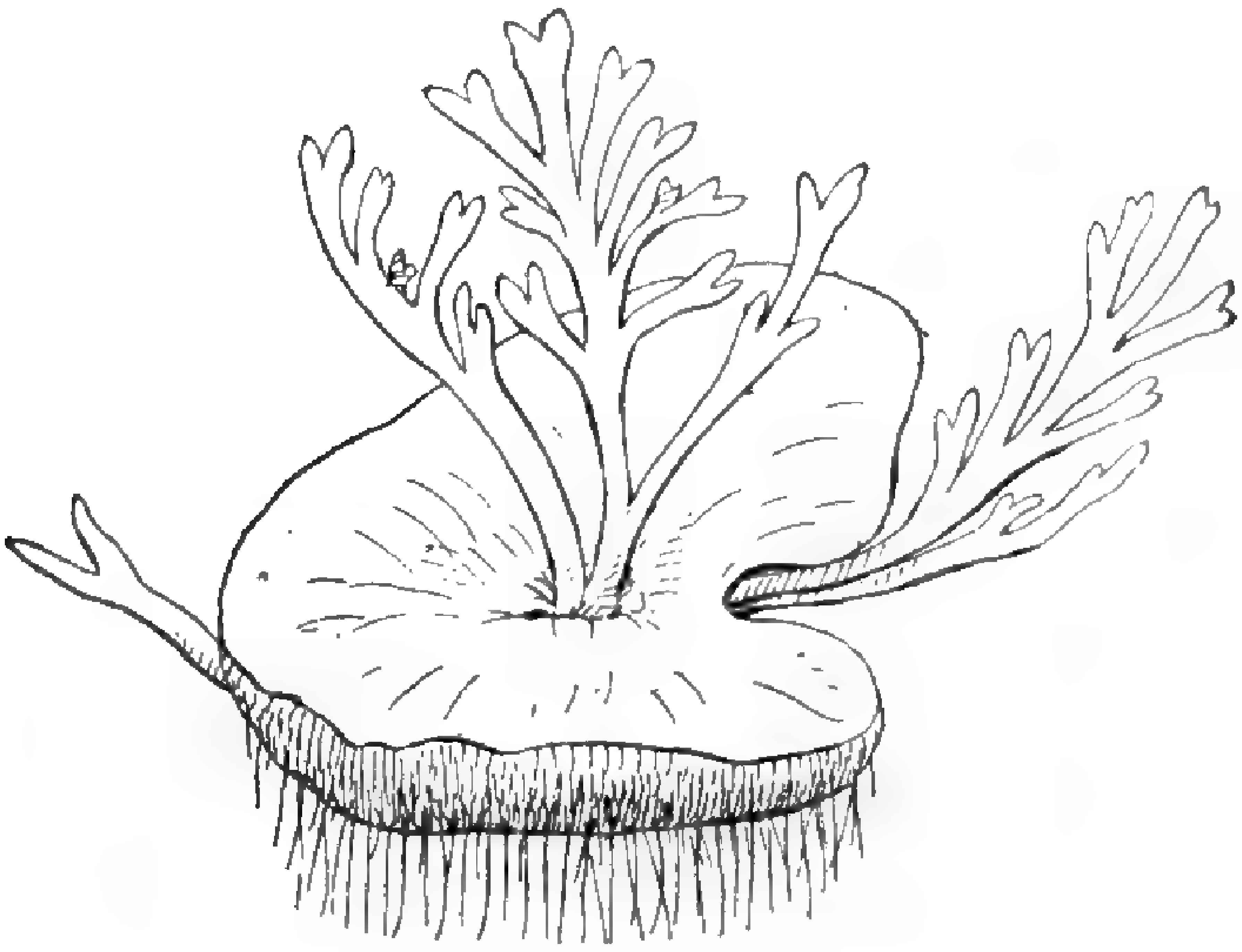

Fig. 4.—Fuller development of first prothallus (fig. 2).

base; the enlarged process begins to look like the stump of a frond, but is not circinate.

*Sept.* 1, 1898.—The fleshy process from prothallus No. 1 has assumed the form of an axis of growth, a bud or crown forming at the bifurcation, and the blunt processes assuming the character of fronds.

*Oct.* 1.—The pinnulets or leaflets upon the various fronds from the prothallus and buds are semi-translucent and lacerated at their edges. I am pinning down a few of them to see if they will develop into prothalli. The first bud which appeared (not from a prothallus) is now a dense tuft of ramulose fronds like the parent *unco-glomeratum*. Prothallus No. 1 has three distinct axes of growth, from all of which ramulose fronds are arising. The prothallus is beginning to shrink.

*Oct.* 18.—Some of the pinnulets which I pinned down on Oct. 1 are obviously growing at their edges, and one or two which do not quite touch the soil are developing root-hairs. These are, however, short and scanty.

*Nov.* 6.—A frondlet is emerging from the sinus of a third prothallus. There does not seem to be any functional difference between the upper and lower surfaces. Close to the sinus the prothallus has twisted upon itself, the under surface coming uppermost and taking on the smooth shining character of the normal upper surface. Root-hairs are emitted from what was the upper but is now the lower surface.

*Dec.* 8.—The root-hairs which were visible a month ago on one of the pinnulets from prothallus No. 1, which was not in contact with the soil, have perished. Those in contact with the soil are living and presumably rooted, but very little growth is now going on.]

## SUMMARY OF RESULTS OF EXPERIMENT.

(1) The fact that detached portions of frond from a deciduous fern can be kept alive for over eighteen months is a little remarkable. Had they been left on the parent plant they would undoubtedly have perished the first winter.

(2) Influence of environment on the development.

(3) The rapidity and energy with which the isolated protoplasm

breaks out when once the tendency to branching has been exhausted and a free cellular tissue produced.

(4) The variety of ways in which this occurs, viz.:—

(1) Gemmation from the rhachis without production of prothalli.
Apospory { (2) (*a*) Apogamic buds from the prothallus.
(*b*) Normal sexual axes of growth from prothallus.

(5) The ease with which apospory is induced in the primary fronds as compared with the extreme difficulty in the case of the adult fronds is characteristic of all aposporous ferns, so far as I know. I have at various times succeeded in raising plants by apospory from eight different ferns—four forms of *Polystichum angulare*, one of *Lastrea paleacea*, and three of *Athyrium Filix-fœmina*; and in every case I have noticed that if the first fronds from the prothallus were pinned down (and, indeed, frequently without this special treatment), the edges rapidly developed into prothalli. Assuming the truth of the recapitulation theory (*i. e.* that ontogeny is an epitome of phylogeny), this would seem to suggest that apospory is an atavic trait in ferns—a character which may have been general or even universal in the infancy of the race. This idea is also borne out to some extent by the fact that apospory is favoured by a uniformly humid atmosphere, a condition which probably prevailed in early geologic (say Silurian and Devonian) times.

(6) The *prima facie* unlikeliness of *A. Filix-fœmina* var. *unco-glomeratum* as a subject for apospory leads me to suspect that that phenomenon could be induced in many—possibly in most—ferns by taking sufficient trouble. This fern has apparently nothing in common with the other abnormal forms which have manifested apospory. All these, so far as I know, belong to the plumose or ultra-plumose sections of varieties. It is true that among them are two other crested ferns, viz., Cropper's *Lastrea paleacea* var. *cristata pulcherrima* and *Scolopendrium* var. *crispum Drummondiæ*; but both these are specially modified forms, whose appearance at once suggests to the experienced eye that they are likely subjects for apospory. It is evident that there is a wide field for further experiments in the cultural inducement of apospory. Some of these further experiments I hope to make and to record results in due time.

NOTE.—On December 18, 1898, I took up one of the original prothalli which had not yet produced either frond or bud, shaved off the root-hairs, and examined it with the microscope for archegonia and antheridia. I found the "cushion" crowded with archegonia, in some of which the egg-cell could be distinctly seen. A few antheridia were found in the usual situation, but they were apparently not yet mature.

On December 29, 1898, I went round my garden and snipped off portions of fronds from some eight different ferns, the only principle of selection being to take fronds which were devoid of any trace of sori, and were not too mature to allow any hope of further growth. They were well washed by a stream of water to remove any adherent spores of other ferns, and were then pinned down in a pot and covered with a bell-glass.

Examining these on January 12, 1899, I found that in the case of one fern, *Polypodium vulgare* var. *grandiceps*, Parker, two translucent (presumably prothallic) growths were already proceeding from the termination of a veinlet near the edge on the upper surface of the frond. These growths, as well as the piece of frond from which they grew, I regret to say have been since destroyed by fungoid growth. I hope, however, to repeat the experiment.

## On some African *Labiatæ* with Alternate Leaves.

By I. H. BURKILL, F.L.S., and C. H. WRIGHT, A.L.S.

[Read 16th February, 1899.]

(PLATE 6.)

A SHORT while ago M. Hua described as the type of a new genus a Labiate from West Tropical Africa, and named it *Icomum paradoxum*. The character upon which he laid most stress is the alternation of the leaves; and on account of this deviation from what is almost universal in the order, he chose the specific name. At the time when his paper* was published we were aware of two Labiates from Africa possessing the same peculiarity; and further search in the herbarium of the Royal Gardens, Kew, had added yet two more. M. Hua, with great courtesy, sent us drawings of *Icomum paradoxum*; and by means of them we are assured of the distinctness of it from any of those which we shall here describe. Thus we know of five African Labiates which possess alternate leaves.

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* "Nouveaux matériaux pour la Flore de l'Afrique Française," Bulletin du Muséum d'histoire naturelle, Paris, 1897, p. 329.

Alternation of leaves is not by any means an unknown condition in this order. Penzig[*] remarks its moderate frequency as an abnormality, and enumerates the following genera in which it has occurred:—*Collinsia*, *Mentha*, *Hyssopus*, *Monarda*, *Physostegia*, *Leonurus*, *Lamium*, and *Dysophylla*. Bentham also described an anomalous *Hyptis* under the name of *H. anomala*[†], reduced later to *H. conferta*[‡], which possesses alternating leaves. Alternation of the flowers of the inflorescence, and of their bracts, is well known in *Scutellaria*, where it characterizes a section (*Heteranthera*), and it also occurs in *Æolanthus*.

All these observations have served as a caution, which we have not disregarded. Yet it seems to us best to retain the genus *Icomum*, and under it we place four of the five plants above mentioned.

*Icomum* is apparently closely allied to *Æolanthus*—a genus confined to Africa, where most of its species occur within the Tropics. We thus diagnose the first-named, and arrange the plants by which it is constituted:—

ICOMUM, *Hua* (*loc. cit.*), Labiatarum-Ocymoidearum genus, *Æolantho* maxime affine: distinguendum foliis alternis sæpissime angustis, floribus in spicis sine ordine obvia aggregatis, bracteis floribus longioribus angustis: cæteris ab *Æolantho* non diversum.

| | |
|---|---|
| Spike compound. | |
| Corolla-tube narrow throughout........ | *I. paradoxum.* |
| Corolla-tube wide above .............. | *I. salicifolium.* |
| Spike simple; corolla-tube only narrow in its lowest third. | |
| Leaves linear........................ | *I. lineare.* |
| Leaves oblanceolate-obovate .......... | *I. subacaule.* |

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[*] Pflanzenteratologie, ii. (Genoa, 1894) p. 231.

[†] Labiatarum Genera et Species (London, 1833), p. 113.

[‡] Bentham in De Candolle's 'Prodromus,' xii. (Paris, 1848) p. 112.

1. ICOMUM PARADOXUM, *Hua*, in Bull. Muséum, Paris, 1897, p. 329.

*Hab.* Timbo, on the river Timbo, one of the upper tributaries of the Senegal. *Dr. Miquel*, 43, in herb. Mus. Paris. Flowering in June.

2. I. SALICIFOLIUM, *Burkill.* (Pl. 6. figs. 1, 2.) *Caules* (? an laterales) 6–10 poll. longi, decumbentes, teretes, dense pubescentes. *Folia* caulina, sessilia, lineari-lanceolata, alterna, apice acuta, basin versus angustata, margine utroque dentibus 2–3 instructa, pubescentia vel glabrescentia, 1–1½ poll. longa, 2–2½ lin. lata. *Inflorescentia* spicis densifloris aggregatis composita; spica terminalis 2 poll. longa; spicæ laterales ad 1 poll. longæ; bracteæ foliis similes sed minores. *Calyx* tubulosus, ad os paullo constrictus, margine leviter sinuatus et pilis conspicue ornatus, florens 1½ lin. longus, fructifer ad 2½ lin. auctus et rima æquali ad basin dissolutus. *Corollæ* extus fere glabræ tubi 3½ lin. longi dimidium inferius angustum, dimidium superius ex inferiori abrupte expansum; labium superius 1¾ lin. longum, dentibus 4 apice rotundatis; labium inferius 2 lin. longum. *Staminum* filamenta 1 lin. longa. *Ovarii* nuculæ ovoideæ; glandula late linguiformis.—*Æolanthus salicifolius*, Baker in Kew Bulletin, 1898, p. 161.

*Hab.* British Central Africa: North Nyasaland, Nyika plateau, 6000–7000 ft. *A. Whyte*, 107. Commencing to fruit in July.

3. I. LINEARE, *Burkill.* (Pl. 6. figs. 3, 4.) *Herba* spithamea. *Caules* erecti, foliis sat crebri, pilis albis aliquo modo puberuli. *Folia* caulina, linearia, sessilia, 4–7 lin. longa, glandulis numerosissimis inconspicue notata. *Spicæ* ramos foliatos terminantes, simplices, 1–1½ poll. longæ; bracteæ foliis similes sed pubescentiores, breviores (2–2½ lin. longæ), paululo latiores; flores ad 15. *Calyx* companulatus, margine leviter sinuatus, florens ¾ lin. longus, basi rimæ indicationem demonstrans. *Corollæ* extra pubescentis tubus ad ⅗ angustus, dein decurvatus ampliatus, 3½–4 lin. longus; labium superius 4-dentatum, 2 lin. longum; labium inferius superiori longius 2½ lin. longum, antheras includens. *Staminum* filamenta 2–2½ lin. longa. *Ovarii* nuculæ ovoideæ; glandula linguiformis.

*Hab.* British Central Africa: Nyasaland, near Fort Young, *Dr. T. G. Nicholson.* Flowering in September.

4. Icomum subacaule, *Burkill.* (Pl. 6. figs. 5, 6.) *Herba* spithamea vel ultra. *Folia* 6–7, ut videtur omnia radicalia, oblanceolato-oblonga, apice obtusa vel rotundata, basin versus longe sensim angustata, utrinque glabra, glandulis conspicue notata, 2½–3 poll. longa, 8–10 lin. lata; petiolus 9–12 lin. longus. *Spicæ* 5–6, simplices, longe pedunculatæ; pedunculus 4–5½ poll. longus, bracteas lineari-lanceolatas alternatim 3–6 irregulariter gerens, pilis parvis sparse tectus; bracteæ steriles et eæ flores subtendentes 2½–5 lin. longæ, glabræ, lineares; flores ad 50. *Calyx* campanulatus, margine leviter sinuatus, aliquo modo bilabiatus, florens vix 1 lin. longus, basi rimæ indicationem demonstrans. *Corollæ* extra pubescentis tubus ad ⅓ angustus, dein fortiter decurvatus ampliatus, 4 lin. longus; labium superius 4-dentatum, dentibus rotundatis, 1¼ lin. longum; labium inferius superiori longius, antheras includens. *Staminum* filamenta 1–1½ lin. longa. *Ovarii* nuculæ apicibus obtusæ; glandula linguiformis.—*Plectranthus subacaulis,* Baker in Kew Bulletin, 1895, p. 73.

*Hab.* British Central Africa: Fwambo, near Lake Tanganyika, *Rev. A. Carson,* 33, 65. Flowering in January.

*Icomum,* as remarked, is very near *Æolanthus*; but although *Æolanthus* shows in many species characters leading to *Icomum,* it is not difficult to define the boundary between the two.

In *Æolanthus* are two very closely allied species—*A. ambustus,* Oliver, and *A. virgatus,* Gürke; so closely are they allied that one may only be a variety of the other, and Briquet * is certainly wrong in making for each of them a section. These two species approach *Icomum* in the narrowness of their leaves and in their inflorescences. In the accompanying woodcut, fig. 5 represents a portion of the inflorescence of *A. virgatus.* As seen in it, the bracts are paired and opposed, but the flowers are solitary—one to each node. There is then an alternation of the flowers, though not of the leaves. In addition, the branches of the lateral axes similarly alternate, though the leaves from which they arise are opposed; while on the main axis, and now and then on the stronger lateral axes, the branches are opposed: so that one may trace a relationship between the vigour of the shoot and the possession of two or one branch (or flower) at each node. But it must be remarked that there is a tendency to anisophylly, the larger leaf (bract) being that without any flower. The difference in size, which is but little, is shown in the figure. It is in no way so obvious as in another member of the Labiatæ—*Pogostemon paniculatum* *.

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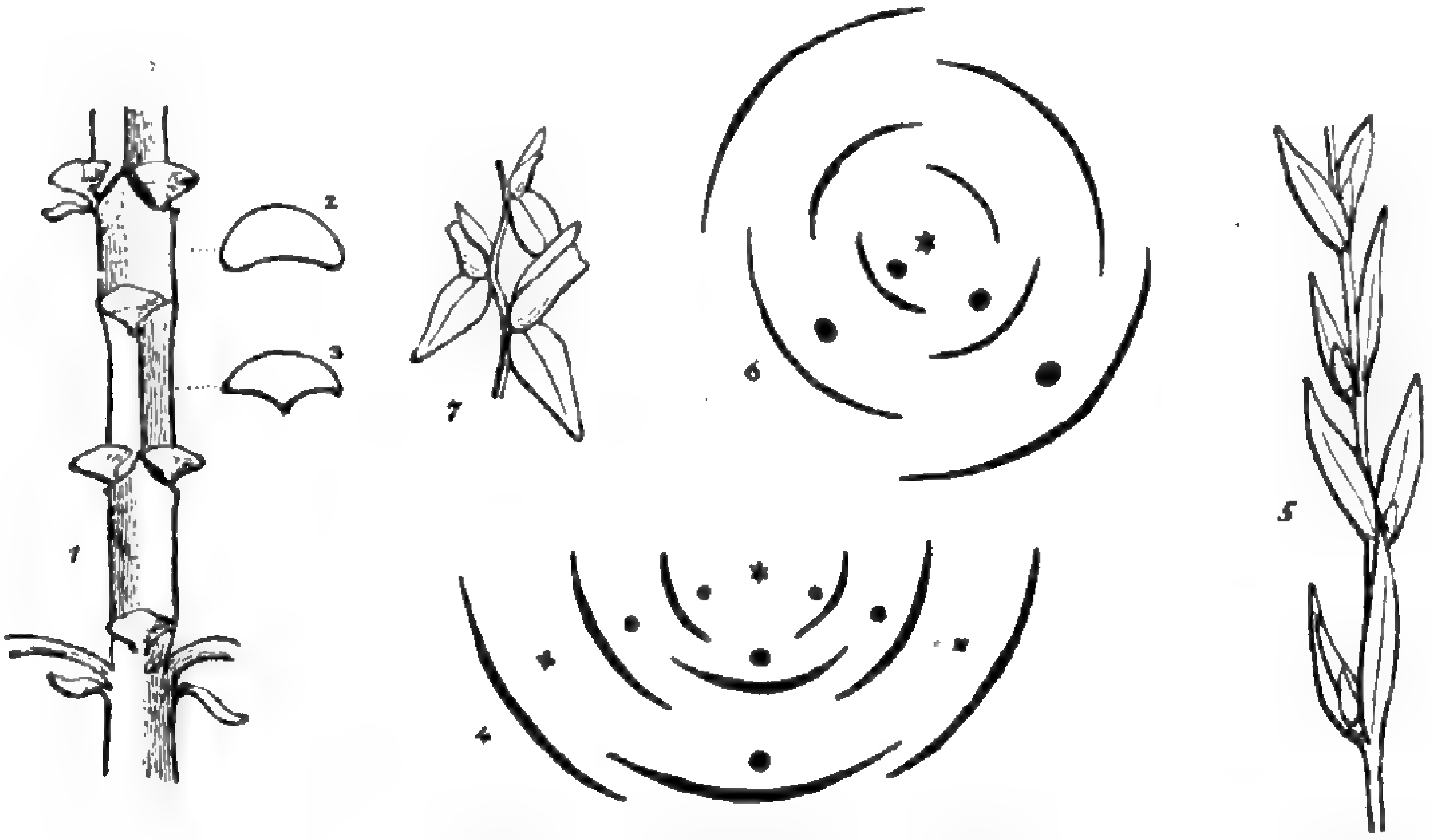
* In Engler u. Prantl, Pflanzenfamilien, iv. 3 A (Leipzig, 1897), p. 349. There is little except the size of the calyx by which the two species can be distinguished.

The position of the flowers is interesting, for, as shown in the diagram (fig. 6), they occupy only two faces of the obscurely quadrangular stem; neither of these faces in the case of lateral axes is turned towards the parent axis.



1. Portion of the inflorescence of *Æolanthus Cameronii*, showing the bases of the calyces of six flowers. 2 & 3. The axis in section, in two consecutive internodes. 4. Diagram of position of flowers. 5. Portion of inflorescence of *Æolanthus virgatus*, showing anisophylly and alternate flowers. 6. Diagram of position of flowers. 7. Portion of inflorescence of *Æolanthus* sp., showing flowers and bracts. 5 and 7 slightly reduced.

The arrangement of the flowers in two rows is common in *Æolanthus*. Another form in which the bracts are approximated is shown in fig. 7, taken from an undescribed species. In several others of the genus the bracts alternate, as do the flowers.

Interesting forms connecting these with a more normal arrangement are seen in *A. Cameronii*, described below, and *A. zanzibaricus*, S. Moore. We shall take first the last-named.

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* *Cf.* also Briquet, 'Monographie du genre *Galeopsis*' (Paris, 1893), p. 35, in which genus a tendency in the same direction occurs.

Of *Æolanthus zanzibaricus* we have seen specimens collected by Hildebrandt (Kingani river, 1265), Johnston (Kilimanjaro Exped.), and Holst (Usambara, 2957). All have the leaves opposed, but in the inflorescence lose this character. At the base of the spike terminating the axis a pair of lateral spikes spring from opposite sides of the stem; sometimes these again branch, but more often they are simple. Examining the terminal spike first, we see that the lowest flowers are sometimes opposed, but more often alternate; at about the middle the decussation of paired flowers is regular, but apt to become irregular again near the apex. On the lateral axes we see invariably a solitary flower at the first internode, which is situated immediately above the bract in the axil of which the axis arose; next, to right and left, a pair of flowers: then one over the first flower; then a pair; and so on. The sterile face of the axis is that directed towards the parent axis.

In *A. Cameronii* * we find a similar arrangement, but all the lateral axes which we have seen possess a sterile face which is turned towards the parent axis. Fig. 1 of the woodcut shows a portion of an axis bearing six flowers; at the very base are two branches; then a solitary flower; next a pair of flowers; then a solitary flower; and so on. Further, the axis is peculiarly grooved as the rhachilla of a grass-spikelet, so that the flowers fit into the hollow spaces, and the face towards the parent axis is much broader than the others. In fig. 4 the position of the flowers and their caducous bracts is marked diagrammatically. It is to be noted that no trace of a bract persists where the flower is absent.

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* ÆOLANTHUS CAMERONII, *Burkill.* *Caules* erecti vel suberecti, pilis perparvis puberuli, obscure angulati, internodiis longis. *Folia* ovata, apice acutiuscula, basi obtusa, margine irregulariter serrata, utrinque minutissime puberula, 10–14 lin. longa, 4–6 lin. lata; petiolus 6–8 lin. longus. *Spicæ* candelabri modo compositæ; spica (terminalis ?) 15–16 lin. longa; spicæ laterales 8–10 lin. longæ, inferiores ad apices pedunculorum longorum semel et iterum trifurcatæ; bracteæ ½–1 lin. longæ, cito deciduæ, subulatæ vel inferiores lanceolatæ, flores dorsiventraliter in foveolis axi, nodis nunc singuli nunc bini alternatim dispositi. *Calyx* bidentatus, pubescens, florens vix 1 lin. longus. *Corollæ* tubus 1 lin. longus nec ampliatus; labium superius rotundatum, margine leviter 4-lobatum, 1 lin. longum; labium inferius superiori paululo longius. *Staminum* filamenta ¾ lin. longa. *Ovarii* nuculæ ovoideæ.

*Hab.* British Central Africa: Shiri Highlands, Namasi, *K. J. Cameron*, 18.

It is probable that we only possess lateral branches of this plant, in which case the terminal inflorescence of the main axis may differ in detail. *A. Candelabrum*, Briquet in Engl. Jahrb. xix. 186, seems to resemble it in habit, but differs much in the flower. The extreme delicacy of the calyx at the time of flowering is very noticeable; and under the microscope a series of large stomata are seen on the terminations of conspicuous anastomosing veins, apparently hydathodes.

These are some modifications of the inflorescence which we have noted in *Æolanthus*. They are of special interest in showing an alternation of parts by abortion of one member of the pair. We have introduced them here that they may afford a contrast between what we see in *Icomum*, in *Æolanthus*, in such abnormalities as the condition of *Hyptis conferta* mentioned above, or that of *Stachys circinata* described by Clos *, and in others where torsion is associated with alternation of the leaves—*e.g.*, a *Collinsia* described by De Vries †.

Schlechtendal long ago spoke of the leaves of Labiates as pseudo-opposite, meaning thereby that there is no connection between the two members which oppose one another. Perhaps there is something in the idea underlying this. When torsion twists the stem of a Labiate the leaves often cease to be opposed, those of each pair becoming separated. This is the commoner abnormality; rarer is separation of the leaves without torsion—a condition which we see in the *Hyptis* and *Stachys* named in the last paragraph. Quite another condition is the alternation by abortion of one of the paired organs, such as we have seen in *Æolanthus*; and distinct again is the alternation which apparently has a spiral arrangement, present in *Icomum*, in the inflorescence of *Scutellaria* § *Heteranthera* and in an interesting abnormality of *Physostegia* described by P. Duchartre ‡, in which the number of leaves at a node was multiplied and these spread out in a spiral.

So much for the genera *Icomum* and *Æolanthus*. There remains yet to be described a species of the genus *Plectranthus*, in which the leaves are irregularly scattered owing to the unequal development of the internodes, and are never truly opposite. The aspect of this plant is similar to that which is often met with in *Linaria vulgaris*, Mill., but the 4-lobed ovary and gynobasic

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* "Théorie des Soudures," Ann. Acad. Toulouse, 8me sér. i. 1879, p. 140.

† "Bijdragen tot de leer van den kleındraai," Bot. Jaarboek, 1892, p. 161.

‡ Bull. Soc. bot. France, xxxix. 1892, p. 120.

Burkill & Wright.

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M. Smith del

J.N. Fitch lith

ALTERNATE LEAVED LABIATÆ

style leave no doubt as to its belonging to the Labiatæ. In the dried state the stem is more or less striate, and it is upon the striations that the leaves are borne. The flowers are alternate and somewhat distant, but occasionally a second bract occurs opposite to that which subtends a flower.

PLECTRANTHUS INSOLITUS, *C. H. Wright.* (Pl. **6**. figs. 7, 8.) *Herba* glabra. *Caulis* erectus, 9 poll. altus, basi ramosus sublignosus, siccitate striatus. *Folia* alterna, linearia vel leviter falcata, acuta, basi attenuata, integra, 1¼ poll. longa, 1 lin. lata. *Racemus* terminalis; bracteæ sæpius alternæ, rarius oppositæ, una vacua, ovato-lanceolatæ, quam pedicelli breviores; pedicelli tenues, 3 lin. longi. *Calyx* campanulatus, extra glandulosus; lobus superior integer, latus; lobi inferiores anguste triangulares. *Corollæ* tubus prope basin contractus, deinde campanulatus; labium inferius extra glandulosum, integrum; superius dentibus 4 subæqualibus obtusis præditum. *Filamenta* basi brevissime connata. *Ovarium* (novellum solum visum) profunde 4-partitum.
*Hab.* Angola, *Welwitsch*, 5593.

It may be thought that the shortly united filaments forbid the placing of this plant in *Plectanthus.* But the genera *Capitanya*, *Englerastrum*, and *Solenostemon*, in which this form of union occurs, are unlike it; and we have preferred to be guided by other characters in leaving it thus as a doubly aberrant form of the large genus *Plectranthus.*

The chief interest of our paper centres in *Icomum*; and the increase of its species from one to four establishes the genus upon a firmer basis as a peculiar development of the Labiatæ, confined to Africa. We do not consider that the relationships of the order are in any way explained by it, as there is no evidence for regarding it as primitive. Still the recognition of a genus in Labiatæ characterized by the possession of alternate leaves lessens the distinctness of the order in what is certainly one of its most prominent features. If, at a later date, we are able to investigate the anatomy of the stem, we shall seize the opportunity.

To M. Henri Hua, for the kind way in which he has given us information about *Icomum paradoxum*, and to Miss M. Smith, who has drawn the plate illustrating the forms we describe, we desire to express our most sincere thanks.

### EXPLANATION OF PLATE 6.

Fig. 1. *Icomum salicifolium*, lateral spike, in fruit. Nat. size.
2. Flower of the same; the calyx in part removed to expose the narrow half of the tube of the corolla.
3. *Icomum lineare.* Nat. size.
4. Flower of the same.
5. *Icomum subacaule.* Nat. size.
6. Flower of the same.
7. *Plectranthus insolitus*, flower.
8. Corolla of the same.

## Note on the Irish *Carex rhynchophysa*.

### By G. Claridge Druce, M.A., F.L.S.

[Read 2nd March, 1899.]

In the 'Journal of Botany' for 1893, on p. 20, an editorial note was inserted to the effect that Mr. R. Lloyd Praeger "had been fortunate enough to add this well-marked species to our British Flora." On pp. 33–35 of the same journal a description of the plant and an account of its discovery is communicated by the finder, Mr. R. Lloyd Praeger. A figure of it with a rather featureless drawing of the perigynium is supplied by Mr. Arthur Bennett, who, Mr. Praeger states, "has now submitted the Sedge to the most rigid examination, and though hesitating at first to add a new plant to the British flora on the strength of a single specimen without the clearest proof, is now convinced of its identity with *Carex rhynchophysa*."

It was discovered in a ten-foot drain with a bottom of deep soft mud and soft peaty sides, which communicated with Mullaghmore Lough in the central part of Armagh, growing in the neighbourhood of *Cicuta virosa* and *Castalia speciosa*. Only one patch, several feet in diameter, was noticed, but this was "immediately distinguished from the groves of *Carex rostrata* which grew around by its taller growth and more glaucous leaves."

The distribution of the true *Carex rhynchophysa* is distinctly northern and eastern. In Finland, as Mr. Praeger points out, it occurs in ten provinces, where it is found on the river- and lake-shores in deep bogs. It is also found in Lapland, Norway, Sweden, Russia, Silesia, Transsylvania, Siberia, and Dahuria.

The alleged discovery of this plant in Ireland was therefore an interesting fact in phyto-geography, as one would rather have expected it to be found in the northern and eastern parts of Scotland than in the central part of Northern Ireland; unless, indeed, it belonged to that abnormal group which comprises *Inula salicina* and *Carex fusca* (*Buxbaumii*), which are almost inexplicable outliers from their ordinary range of distribution.

Mr. Praeger's original gathering consisted, as has been said, of a single specimen, but he found it in one or two additional places at Mullaghmore in succeeding seasons. Last August, having to attend a conference at Belfast, I resolved to search for this rare and interesting Sedge, and with only the details given in the 'Journal of Botany' to assist me in the quest; but after a careful examination of some Finland specimens, and the figure and description in the 'Journal of Botany,' I set out from Belfast to the remote locality indicated, very near to Lough Swilly Station, not far from which I came upon the Lough. Notwithstanding the dry season, the water in the marshes at the head was rather higher than was formerly the case, owing, as I was informed, to the drains at the outlet being overgrown with vegetation. I commenced a search for the Sedge, which lasted between three and four hours. In this comparatively thorough investigation I could not help admiring the magnificent tufts of *Cicuta*, and in addition *Potamogeton obtusifolius* and *Utricularia major* were noticed; but the plant of the marshy borders of the Lough was *Carex rostrata*, which I had never previously seen so luxuriant, nor, indeed, so variable in size.

In what I took to be Mr. Praeger's locality, I found a tuft of a broad glaucous-leaved Sedge which answered to my recollection of the figure in the 'Journal of Botany.' The thicker spikelets, large fruits, and very broad leaves, in some cases nearly ¾ inch broad, with thick spongy stem, measuring in the submerged part between 3 and 4 inches round, appearing very different from *Carex rostrata* as seen in our Midland bogs; and yet it was difficult to see any sharp line of demarcation between these specimens and others which grew in shallower water, or again between the latter and plants growing in the marsh itself. Even in the marsh the leaves of plants having the spikes and fruits of ordinary *rostrata* had the leaves somewhat broader than our usual English form, and they were decidedly glaucous. None of these plants, whether growing in the marsh, or in shallow water, or in the deeper water of the drain itself, showed the peculiar outline and shape of the fruit which I take to be characteristic of the Finland and North European plant; although those from the drain, and others also growing in other ditches and drains near the Lough, seemed to be, so far as my recollection went, identical with the plant figured in the 'Journal of Botany' as *C. rhynchophysa*. The spikes also varied considerably in shape, some with large fruit being much longer and comparatively thinner than those figured, while others with short, stout spikes had smaller fruit.

Therefore, after the somewhat prolonged search, I came away very sceptical as to having gathered the true *C. rhynchophysa*; and on reaching home, a comparison of my specimens with Finland, Swedish, and Russian plants convinced me that I had been unsuccessful. On the other hand, my specimens appeared to be inseparable from the plant figured in the 'Journal of Botany' as *C. rhynchophysa*. I therefore communicated with Mr. Praeger, and he kindly told me that he had presented specimens to the herbaria of Kew and the British Museum. At the earliest opportunity I consulted the herbaria of the latter institution, but found that the Irish *Carex rhynchophysa* had not yet been placed amongst the British plants. At Kew I was more fortunate, for, kindly assisted by Mr. C. B. Clarke and Mr. N. E. Brown, I was enabled to examine Mr. Praeger's specimen. This, with all deference to Mr. Arthur Bennett's well-known knowledge, is in my opinion not the true *C. rhynchophysa* of North European botanists, but an extreme form of *Carex rostrata*, Stokes, which has been called var. *latifolia* by Ascherson, and agrees exactly with some of my specimens of that plant collected at Mullaghmore and corroborated by Pfarrer Kükenthal. Messrs. Clarke and Brown also agree with me in referring my own plants and that of Mr. Praeger to *C. rostrata*, and in considering that neither is identical with true *C. rhynchophysa* from Northern Europe. From this it differs, as Mr. Brown observes, in the spikes of the Irish plant being not so stout in proportion to their length, in being usually longer, in the utricles being not so crowded as they are in *C. rhynchophysa*, thus giving the spikes a different appearance; in the utricle of the Irish plant being not so abruptly contracted into a beak, and in the beak being shorter and much less deeply bifid than in *C. rhynchophysa*. It also appears to be rather more slender than in that species. I therefore venture to contend that *C. rhynchophysa* of Fisch., Mey. & Avé-Lall. Ind. Sem. Hort. Petrop. ix. Suppl. 9, is still a desideratum to the flora of Great Britain and Ireland.

# A further Contribution to the Freshwater Algæ of the West Indies. By W. West, F.L.S., and G. S. West, B.A., A.R.C.S.

[Read 16th March, 1899.]

The Algæ included in this paper were collected mainly in the Island of Dominica by Mr. W. R. Elliott in January and February, 1896, and consisted of dried specimens, numbered and localized. The numbers following the localities refer to the numbered sheets at the British Museum, at which place the specimens can be consulted.

In 1894 we published a short paper "On some Freshwater Algæ from the West Indies" (Journ. Linn. Soc., Bot. vol. xxx.), in which 63 species were recorded from the islands of Dominica and St. Vincent, and the present paper considerably enlarges our knowledge of West Indian species of these plants. Of the 63 species mentioned in the previous paper, 21 have been found in other localities, and 66 additional ones are recorded, the latter being prefixed by an asterisk (*). One species (*Rhaphidium fractum*) and two varieties (*Mesotænium Kramstai*, Lemmerm., var. *brevis*, and *Cylindrocystis tumida*, F. Gay, var. *dominicensis*) are described as new. One alga, *Lyngbya majuscula*, Harv., is truly a marine species, but it was found in the collection, and is therefore recorded.

A number of both Desmids and Diatoms were noted from subaërial habitats—a sure indication of a constantly moist atmosphere; these occurred chiefly among patches of *Scytonema*, *Schizothrix*, and other filamentous algæ, and often on trees.

In the measurements given of the Myxophyceæ in this paper, "crass. fil."=the diameter of the sheath containing the trichomes, and "crass. trich."=the diameter of the cells without the sheath.

## Class CHLOROPHYCEÆ.

### Ord. CONFERVACEÆ ISOGAMÆ.

### Fam. CONFERVACEÆ.

*1. MICROSPORA ABBREVIATA, *Lagerh. in Bericht. Deutsch. Bot. Gesellsch.* v. 1887, p. 417.—Conferva abbreviata, *Rabenh. Krypt. Flor. v. Sachs.* 1863, p. 246; *Flor. Europ. Algar.* iii. p. 323.

*Hab.* On roadside near Roseau Lake, Dominica (2700 ft.). No. 1160.

*2. MICROSPORA PACHYDERMA, *Lagerh. l. c.*—Conferva pachyderma, *Wille*, "*Om Hvilecell. hos Conferva,*" *Öfvers. af K. Vet.-Akad. Förh.* 1881, no. 8, p. 20.

*Hab.* On rocks, Castle Bruce River, Dominica (2000–3000 ft.). No. 1697.

### Fam. CHROOLEPIDACEÆ.

3. TRENTEPOHLIA VILLOSA, *De Toni, Syll. Algar.* i. p. 239.—Chroolepus villosa, *Kuetz. Phyc. gener.* p. 284; *Spec. Algar.* p. 428.

Crass. cell. veget. 18–22 μ.

*Hab.* On trees in woods round Roseau Lake, Dominica. No. 1164.—On trees, St. Aroment, Roseau, Dominica. No. 1254.

A species was noticed on banks at Emsol, Roseau, Dominica. No. 986. The specimens were probably young forms of *T. villosa*. Branches few, short, and situated at long intervals along the primary filaments.

Crass. fil. 18–20 μ.

*4. TRENTEPOHLIA sp.

Specimens very fragmentary; thickness of cells 8·5–14·5 μ, 1½ times longer than their diameter.

*Hab.* Roseau Valley, Dominica, on bark. No. 1344.

### Fam. CLADOPHORACEÆ.

*5. RHIZOCLONIUM HIEROGLYPHICUM, *Kuetz. Phyc. gener.* p. 205; *Spec. Algar.* p. 385; *Stockmayer*, "*Ueber die Algen-*

*gattung Rhizoclonium,*" *Verhand. zool.-bot. Gesellsch. Wien*, 1890, p. 578.

Var. TORTUOSUM, *Stockm. in Verh. zool.-bot. Gesellsch. Wien*, 1890, p. 583.—Rhizoclonium tortuosum, *Kuetz. Phyc. Germ.* p. 205; *Spec. Algar.* p. 384.

Short lateral branches entirely absent; cell-membrane lamellose.

Crass. fil. 25–32·5 μ; crass. membr. cell. 3·5–5·5 μ.

*Hab.* Growing in small stream, Roseau Valley, Dominica. No. 1176.

## Ord. CONJUGATÆ.

### Fam. ZYGNEMACEÆ.

*6. MOUGEOTIA sp.

Crass. cell. veget. 8·6 μ.

*Hab.* On leaves in warm stream, road to Roseau Lake, Dominica (2500 ft.). No. 1178.

*7. ZYGNEMA ERICETORUM, *Hansg. in Archiv Naturw. Landesdurchf. von Böhmen*, Bd. vi. 1888, pp. 155–6.—Zygogonium ericetorum, *Kuetz. Phyc. gener.* 1843, p. 280.

Crass. cell. veget. 16–22 μ.

*Hab.* On bank, road to Lake, Dominica. No. 1222.—In stream, Wotten Waven, Dominica. No. 1248.—On ground, crater, Grande Soufrière, Dominica. Nos. 1835 and 1840.

*8. SPIROGYRA NEGLECTA, *Kuetz. Species Algar.* 1849, p. 441. —Zygnema neglecta, *Hass. Brit. Freshw. Alg.* 1845, p. 142, t. 23. ff. 1, 2.

Var. TERNATA, *West & G. S. West*, "*Welw. Afric. Freshw. Alg.*," *Journ. Bot.* xxxv. 1897, p. 41.—S. ternata, *Ripart, in Bull. Soc. Bot. Fr.* xxiii. 1876, p. 162.

Crass. cell. veget. 44–57 μ; long. zygosp. 84–100 μ; lat zygosp. 48–54 μ.

*Hab.* In stream, Wotten Waven, Dominica. No. 1248.

*9. CHOASPIS STICTICA, *O. Kuntze, Revis. Gen. Plant.* 1891, p. 887.—Conferva stictica, *Engl. Bot.* Choaspis serpentaria, *S. F. Gray, Arrangement Brit. Pl.* 1821, vol. i. p. 299 (nomen prius). Sirogonium sticticum, *Kuetz.*

Crass. cell. veget. 36–41 μ; long. zygosp. 90–104 μ; lat. zygosp. 57–61 μ.

*Hab.* On bank at roadside, Emsol, near Roseau, Dominica. No. 983.

Gray's description of *Choaspis* is a very good one of the plant, and is twenty-two years previous to Kuetzing's description of *Sirogonium*. We think that the peculiar conjugation sufficiently separates this genus from *Spirogyra*.

### Fam. DESMIDIACEÆ.

*10. GONATOZYGON RALFSII, *De Bary, Conj.* p. 76–7, t. 4. ff. 23-25.

Long. cell. 224 μ; lat. 12·5 μ.

*Hab.* Head of Castle Bruce River, Dominica. No. 1484.

*11. MESOTÆNIUM ENDLICHERIANUM, *Näg. Gattung. einz. Alg.* 1849, p. 109, t. vi. B.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.

*12. M. KRAMSTAI, *Lemmermann*, "*Zur Algenfl. des Riesengebirges,*" *Forschungsberichte aus der Biol. Stat. zu Plön.* iv. 1896, pp. 115-117, c. fig.

Var. BREVIS, var. nov.

Var. cellulis angustioribus brevioribusque.

Long. 25–34·5 μ; lat. 6·5–7 μ.

*Hab.* On bank, Morne Micotrin, Dominica. No. 1109.

13. M. MICROCOCCUM, *Kirchn. Alg. Schles.* p. 134.—Palmoglœa micrococca, *Kuetz. Tab. phycolog.* i. p. 20, t. 25. f. 5.

Long. 17–18 μ; lat. 8–8·5 μ.

*Hab.* On bank, road to Lake, Dominica (2700 ft.). No. 1222.

*14. CYLINDROCYSTIS TUMIDA, *F. Gay*, '*Essai monogr. loc. Conj.,*' *Montpellier*, 1884, p. 52, t. 1. f. 1; "*Note Conj. du midi France,*" *Bull. Soc. bot. Fr.* vol. xxxi. p. 334.

Var. DOMINICENSIS, var. nov.

Var. cellulis multe minoribus, diametro 2–2¼-plo longioribus, ad medium leviter sed distincte constrictis.

Long. 42·5–48 μ; lat. 20–21 μ.

*Hab.* On rocks, Castle Bruce River (2000–3000 ft.), Dominica. No. 1697.

*15. PENIUM CURTUM, *Bréb. in Kuetz. Species Algar.* 1849, p. 167.—Closterium curtum, *Bréb.* 1840. Cosmarium curtum, *Ralfs, Brit. Desm.* p. 109, t. 32. f. 9.

*Hab.* With the preceding species.

*16. P. DIDYMOCARPUM, *Lund.*, "*Desm. Suec.*," *Act. Reg. Soc. Scient. Upsal.* 1870, p. 85, t. 5. f. 9.

Forma cellulis latioribus; long. 29 μ; lat. 17 μ.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.

This form is somewhat similar to the "*Penium* sp.? mit *Penium didymocarpum* Lundell verwandt" figured by Heimerl in Verhandl. zool.-botan. Gesellsch. Wien, 1891, t. 5. f. 5, but is comparatively a little broader.

*17. P. NAVICULA, *Bréb. in Mém. Soc. Sc. Nat. Cherbourg*, vol. iv. 1856, p. 146, t. 2. f. 37.

Long. 30 μ; lat. 11·5 μ.

*Hab.* Among *Trentepohlia villosa*, De Toni, on trees in woods round Roseau Lake, Dominica. No. 1164.

18. TETMEMORUS LÆVIS, *Ralfs, Brit. Desm.* p. 147, t. 24. f. 2.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.

*19. T. GRANULATUS, *Ralfs in Ann. & Mag. Nat. Hist.* vol. xiv. 1844, p. 257, t. 8. f. 2; *Brit. Desm.* p. 147, t. 24. f. 2, t. 33. f. 1.

Forma MINOR, *Nordst. Alg. Sandvic.* p. 10.

Long. 100 μ; lat. 26·5 μ.

*Hab.* On roadside near Roseau Lake (2700 ft.), Dominica. No. 1160.

20. COSMARIUM PSEUDOPYRAMIDATUM, *Lund.*, "*Desm. Suec.*," *Act. Reg. Soc. Scient. Upsal.* 1870, p. 41, t. 2. f. 18.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.—On bank near Roseau Lake (2700 ft.), Dominica. No. 1180.

A proportionately longer form was noticed: long. 57 μ; lat. 28 μ; lat. isthm. 12 μ.

*21. C. QUADRATUM, *Ralfs in Ann. & Mag. Nat. Hist.* vol. xiv. 1844, p. 395, t. 11. f. 9.

A small form: long. 46 μ; lat. 26·5 μ; lat. isthm. 12 μ.

*Hab.* In warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1177.

*22. COSMARIUM RECTANGULARE, *Grun. in Rabenh. Flor. Europ. Algar.* iii. p. 166.—C. gotlandicum, *Wittr. in Bih. till K. Sv. Vet.-Akad. Handl.* Bd. i. no. 1, p. 60, t. 4. f. 14.

A form somewhat approaching var. *africanum*, West & G. S. West ("Algæ from Central Africa," Journ. Bot. xxxiv. 1896, p. 379, t. 361. f. 14).

Long. 31 μ; lat. 23 μ; lat. isthm. 10 μ.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.

23. C. OBLIQUUM, *Nordst.*, "*Norges Desmid.*," *Acta Univ. Lund*, vol. ix. p. 23, t. 1. f. 8.

Long. 19–22 μ; lat. 16·5–17 μ; lat. isthm. 6·5–8 μ; crass. 9·5 μ.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.—On rocks, Castle Bruce River (2000–3000 ft.), Dominica. No. 1697.

*24. C. LÆVE, *Rabenh. Flor. Europ. Algar.* iii. p. 161; *Nordst. in Öfvers. af K. Vet.-Akad. Förh.* 1876, no. 6, p. 29, t. 12. f. 4.

Long. 30 μ; lat. 19 μ; lat. isthm. 7 μ.

*Hab.* On leaves, Wotten Waven, Dominica. No. 1240.

*25. C. ANNULATUM, *De Bary, Conj.* p. 46.—Dysphinctium annulatum, *Näg. Gattung. einz. Alg.* p. 110. t. 6 F.

Var. ELEGANS, *Nordst.*, "*Norges Desmid.*," *Acta Univ. Lund*, vol. ix. p. 23.

Long. 36–39 μ; lat. 19–21 μ.

*Hab.* On rocks, Castle Bruce River (2000–3000 ft.), Dominica. No. 1697.

*26. HYALOTHECA DISSILIENS, *Bréb. in Ralfs, Brit. Desm.* p. 51, t. 1. f. 1.

Lat. 17 μ.

*Hab.* On leaves in warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1178.

## Ord. PROTOCOCCOIDEÆ.

### Fam. PALMELLACEÆ.

*27. RHAPHIDIUM FRACTUM, sp. n.

*R.* cellulis semper singulis, gregariis, leviter curvatis, diametro

7–10-plo longioribus, apices versus plus incurvatis, apicibus acutis; contentum chlorophyllosum cellularum viride, in partibus subæqualibus quatuor distincte divisum.

Long. 19–36·5 μ; lat. 2·6–3·4 μ.

*Hab.* In stream, Wotten Waven, Dominica. No. 1249.

This species is nearest to *Rhaphidium Braunii*, Näg. (in Kuetz. Spec. Algar. p. 891; Rabenh. Flor. Europ. Algar. iii. p. 45), but the form of the cells, which are narrower, and the peculiar division of the contents easily distinguish it. Some specimens were noticed in which the contents were divided into 3 or 5 parts, but these were abnormal and very scarce.

*28. Oocystis solitaria, *Wittr. in Wittr. & Nordst. Alg. Exsic.* no. 244.

*Hab.* On trees in woods round Roseau Lake, Dominica. No. 1164.

*29. Glœocystis gigas, *Lagerh. in Öfvers. af K. Vet.-Akad. Förh.* 1883, no. 2, p. 63.—Protococcus gigas, *Kuetz. Phyc. Germ.* 1845, p. 145. Chlorococcum gigas, *Grun.*

*Hab.* With the preceding species.

*30. Trochiscia aspera, *Hansg. in Hedwigia*, 1888, Heft 5 u. 6.—Acanthococcus aspera, *Reinsch, in Berichte der Deutsch. bot. Gesellsch. in Berlin*, 1886, p. 239, t. 11. f. 2.

Diam. cell. 15–17·5 μ.

*Hab.* In stream, Wotten Waven, Dominica. No. 1249.

## Class MYXOPHYCEÆ.

### Ord. HORMOGONEÆ.

### Sub-ord. HETEROCYSTEÆ.

### Fam. RIVULARIACEÆ.

*31. Calothrix epiphytica, *West & G. S. West*, "*Welw. Afric. Freshw. Alg.*," *Journ. Bot.* xxxv. 1897, p. 240.

*Hab.* Epiphytic on *Tolypothrix byssoidea*, on leaves, Wotten Waven, Dominica. No. 1240.

### Fam. SIROSIPHONIACEÆ.

32. HAPALOSIPHON INTRICATUS, *West*, "*Alg. from West Indies*," *Journn. Linn. Soc., Bot.* vol. xxx. (1894) p. 271–2, t. 15. ff. 16–28; *West & G. S. West*, "*Welw. Afric. Freshw. Alg.*," *Journ. Bot.* xxxv. 1897, p. 242.

*Hab.* In stream, Wotten Waven, Dominica. No. 1249.

33. STIGONEMA HORMOIDES, *Born. et Flah.*, "*Révis. de Nostoc. Hétérocyst.*," *Ann. Sci. Nat.* 7ᵉ série, *Bot.* vol. v. (1887) p. 69.—Scytonema hormoides, *Kuetz.* Sirosiphon brevis, *Kuetz. in Bot. Zeit.* 1847, p. 196; *Tab. Phyc.* ii. p. 10, t. 34. f. ii. Sirosiphon hormoides, *Kuetz. Spec. Algar.* p. 316; *Tab. Phyc.* ii. p. 10, t. 34. f. iv.

Crass. fil. 10–14·5 $\mu$.

*Hab.* Abundant on banks, Morne Micotrin, Dominica. No. 1109.—On roadside and on bank, near Roseau Lake (2700 ft.), Dominica. Nos. 1160 and 1180.—On rocks, Castle Bruce River, (2000–3000 ft.), Dominica. No. 1697.

34. S. MINUTUM, *Hass. Brit. Freshw. Alg.* i. p. 230, t. 67. ff. 3–4; *Born. et Flah. l. c.* pp. 72–74.

*Hab.* In stream, Wotten Waven, Dominica. No. 1249.

*35. S. OCELLATUM, *Thur. in Ann. Sc. Nat.* 6ᵉ sér. *Bot.* i. (1875) p. 380.—Sirosiphon ocellatus, *Kuetz. Spec. Algar.* p. 317; *Tab. Phyc.* ii. p. 11, t. 37. f. ii.

*Hab.* On rocks, Castle Bruce River (2000–3000 ft.), Dominica. No. 1697.

### Fam. SCYTONEMACEÆ.

36. MICROCHÆTA TENUISSIMA, *West*, "*Alg. West Ind.*," *Journ. Linn. Soc., Bot.* vol. xxx. (1894) p. 269.

*Hab.* With the preceding species.

37. SCYTONEMA AMBIGUUM, *Kuetz. Spec. Algar.* p. 894; *Tab. Phyc.* ii. p. 7, t. 26. f. ii.

Crass. fil. 10·5 $\mu$; crass. trich. 2·7–3 $\mu$.

*Hab.* On bank near summit, Couliabon (3700 ft.), Dominica. No. 1899.

*38. SCYTONEMA HOFMANNI, *Agardh*, *Syn. Algar. Scand.* 1817, p. 117; *Born. et Flah.*, "*Revis. des Nostoc. Hétérocyst.*," *Ann. des Sci. Nat.* 7ᵉ sér. *Bot.* vol. v. (1887) p. 97.—Scytonema Julianum, *Menegh.*

The filaments, which were not incrusted with lime, were strongly agglutinated together in vertical tufts about 2 to 4 mm. high, in the manner of a *Symploca* or some species of *Schizothrix*. The sheath was perfectly colourless and very thin; the branches were very scarce and sometimes single. The cells were more often longer than broad, and varied from subquadrate to twice longer than their diameter.

Crass. fil. 9·5–10·5 μ; crass. trich. 7–7·5 μ.

*Hab.* Head of Castle Bruce River, Dominica. No. 1484.

39. S. AMPLUM, *West*, "*Alg. West Indies*," *Journ. Linn. Soc.*, *Bot.* vol. xxx. (1894) p. 270.

*Hab.* On rocks, Castle Bruce River (2000–3000 ft.), Dominica. No. 1697.

40. S. MIRABILE.—Conferva mirabilis, *Dillw.* Scytonema figuratum, *Agardh*, *Syst. Algar.* p. 38. S. calotrichoides, *Kuetz. Spec. Algar.* p. 307; *Tab. Phyc.* ii. p. 6, t. 22. f. ii.; *Rabenh. Flor. Europ. Algar.* ii. p. 253.

Crass. fil. 20–23 μ; crass. trich. 7·5–9·5 μ.

*Hab.* On rocks, Hampstead Valley (850 ft.), Dominica. No. 2171.

*41. TOLYPOTHRIX BYSSOIDEA, *West & G. S. West*, "*Welw. Afric. Freshw. Alg.*," *Journ. Bot.* xxxv. 1897, p. 267.—Hassallia byssoidea, *Hass. Brit. Freshw. Alg.* i. p. 233–4; ii. t. 67. f. 5; *Born. et Flah.*, "*Revis. des Nostoc. Hétérocyst.*," *Ann. Sci. Nat.* 7ᵉ sér. vol. v. (1887) p. 116.

Crass. fil. 16·5–18 μ; crass. trich. 10·5–12·5 μ.

*Hab.* On leaves, Wotten Waven, Dominica. No. 1240.

Although the form seen occurred on the leaves of trees, it agreed with the f. *saxicola*, Grunow (in Born. et Flah. *l. c.* p. 117) and not with the f. *lignicola*, Born. et Flah. The sheaths of the younger filaments were almost colourless, and those of the older filaments were somewhat rough on the exterior. The cells in some of the filaments were almost as long as broad.

### Fam. NOSTOCEÆ.

*42. NOSTOC MUSCORUM, *Agardh, Dispos. Algar. Suec.* 1812, p. 44; *Cooke, Brit. Freshw. Alg.* p. 230, t. 90. ff. 12–18.

The specimens approached var. *tenax*, Thuret, in the thickness of the trichomes and in the small size of the spores.

Crass. trich. 3–3·5 μ; crass. heterocyst. 5·5 μ; crass. spor. 6–7·5 μ.

*Hab.* Growing on sides of road, Fort Charlotte, St. Vincent. No. 203.

43. N. HUMIFUSUM, *Carm. ex Harvey in Sm. Engl. Flora*, 1833, v. p. 399; *Kuetz. Spec. Algar.* p. 301; *Rabenh. Flor. Europ. Algar.* ii. p. 183.

*Hab.* In stream, Wotten Waven, Dominica. No. 1249.

## Sub-ord. HOMOCYSTEÆ.

### Fam. VAGINARIEÆ.

*44. PORPHYROSIPHON NOTARISII, *Kuetz. Tab. Phyc.* ii. 1850–2, p. 7, t. 27. f. i.; *West & G. S. West*, "*Welw. Afric. Freshw. Alg.*," *Journ. Bot.* xxxv. 1897, p. 271.

Crass. fil. 20–23 μ; crass. trich. 14 μ.

*Hab.* On the sides of road, Fort Charlotte, St. Vincent. No. 203.

45. SCHIZOTHRIX CUSPIDATA, *West & G. S. West in Journ. Roy. Micr. Soc.* 1896, p. 164.—Symploca cuspidata, *West*, "*Alg. West Ind.*," *Journ. Linn. Soc., Bot.* vol. xxx. (1894) p. 273, t. 16. ff. 1–7.

Var. LUTEO-FUSCA, *West & G. S. West*.—Symploca cuspidata var. luteo-fusca, *West, l. c.* (1894) p. 274.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.—On roadside near Roseau Lake (2700 ft.), Dominica. No. 1160.—On bank near summit, Couliabon (3700 ft.), Dominica. No. 1899.

### Fam. LYNGBYEÆ.

*46. LYNGBYA MAJUSCULA, *Harv. in Sm. Engl. Fl.* 1833, v. p. 370; *Gomont, Monogr. des Oscillariées*, pp. 151–6, t. 3. ff. 3–4.

Crass. fil. 40–46 μ; crass. trich. 34–38 μ.
*Hab.* Shallow bays, Anguilla. No. 20.

*47. **Lyngbya ærugineo-cærulea**, *Gomont, Monogr. des Oscillariées*, p. 166, t. 4. ff. 1–3.—Oscillaria ærugineo-cærulea, *Kuetz. Phyc. gener.* p. 185; *Tab. Phyc.* i. p. 28, t. 39. f. ix.
Crass. trich. 4–5·5 μ.
*Hab.* On leaves in warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1178.—On ground (2000–3000 ft.), and in stream, crater of Grande Soufrière, Dominica. Nos. 1832 and 1842.

*48. **Phormidium luridum**, *Gomont, l. c.* p. 185–6, t. 4. ff. 17–18.—Leptothrix lurida, *Kuetz.*
Crass. trich. 2 μ.
*Hab.* Growing on sides of road, Fort Charlotte, St. Vincent.

*49. **P. fragile**, *Gomont, l. c.* p. 183–4, t. 4. ff. 13–15.—Anabæna fragilis, *Menegh.*
Crass. trich. 1·7 μ.
*Hab.* In stream, Wotten Waven, Dominica. No. 1249.

### Ord. CHROOCOCCACEÆ.

*50. **Glœocapsa gelatinosa**, *Kuetz. Phyc. gener.* p. 174; *Tab. Phyc.* i. t. 20. f. vi. *b*; *Rabenh. Flor. Europ. Algar.* ii. p. 39.
Diam. cell. 2·5–3 μ; diam. fam. 7·5–19 μ.
*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.

## Class BACILLARIEÆ.

### Ord. RAPHIDIEÆ.

### Fam. CYMBELLEÆ.

*51. **Cymbella Cistula**, *Kirchn.*—Cocconema Cistula, *Hempr.* 1828; *Van Heurck, Diatom.* (Engl. transl.) p. 149, t. 1. f. 45.
*Hab.* On rocks, Castle Bruce River (2000–3000 ft.), Dominica. No. 1697.

*52. **Encyonema ventricosum**, *Kuetz. Bacill.* p. 80, t. 6. f. 16.—Cymbella ventricosa, *Agardh.*
*Hab.* With the preceding species.

### Fam. NAVICULEÆ.

*53. NAVICULA MAJOR, *Kuetz. Bacill.* t. 4. f. 19.—Pinnularia major, *Rabenh. Süssw. Diatom.* p. 42, t. 6. f. 5; *Flor. Europ. Algar.* i. p. 210.

*Hab.* On bank near Roseau Lake (2700 ft.), Dominica. No. 1180.—In stream, Wotten Waven, Dominica. Nos. 1248 and 1249.

*54. N. VIRIDIS, *Kuetz. Bacill.* t. 4. f. 18.—Pinnularia viridis, *Rabenh. Süssw. Diatom.* p. 42, t. 6. f. 4; *Flor. Europ. Algar.* i. p. 212.

*Hab.* On bank near Roseau Lake (2700 ft.), Dominica. No. 1180.—In stream, Wotten Waven, Dominica. No. 1248.

55. N. BOREALIS, *Kuetz.*—Pinnularia borealis, *Ehrenb.*; *W. Sm. Brit. Diat.* ii. p. 94; *Rabenh. Flor. Europ. Alg.* i. p. 216.

*Hab.* Among *Nostoc muscorum*, Agardh, on side of road, Fort Charlotte, St. Vincent. No. 203.—On banks, Emsol, near Roseau, Dominica. No. 983.

*56. N. HILSEANA, *Janisch in Schmidt, Atlas Diatom.* p. 45, f. 65; *Van Heurck, Diatom.* (Engl. transl.) p. 171, t. 2. f. 81.

*Hab.* Among *Lyngbya ærugineo-cærulea*, Gomont, on ground, crater of Grande Soufrière (2000–3000 ft.), Dominica. No. 1832.

*57. N. SUBCAPITATA, *Greg. in Quart. Journ. Micr. Sci.* 1856, p. 9, t. i. f. 30; *Van Heurck, Diatom.* (Engl. transl.) p. 173, t. 2. f. 91.

*Hab.* In small stream, Roseau Valley, Dominica. No. 1176.

*58. N. APPENDICULATA, *Kuetz. Bacill.* p. 93, t. 3. f. 18; *Van Heurck, l. c.* p. 173, t. 2. f. 93.

*Hab.* On ground, crater of Grande Soufrière (2000–3000 ft.), Dominica. No. 1832.

*59. N. GLOBICEPS, *Greg. in Quart. Journ. Micr. Sci.* 1856, p. 10, t. i. f. 34; *Van Heurck, l. c.* p. 173, t. 2. f. 94.

*Hab.* On bank near Roseau Lake (2700 ft.), Dominica. No. 1180.

*60. N. LEGUMEN, *Ehrenb.*; *Van Heurck, l. c.* p. 174, t. 2. f. 98.

*Hab.* In small stream, Roseau Valley, Dominica. No. 1176.—In stream, Wotten Waven, Dominica. No. 1248.

*61. NAVICULA GRACILIS, *Kuetz. Bacill.* p. 91, t. 3. f. 48; *Van Heurck, l. c.* p. 179, t. 3. f. 109.

*Hab.* On bank at roadside, Emsol, near Roseau, Dominica. No. 983.

62. N. CRYPTOCEPHALA, *Kuetz.*; *W. Sm. Brit. Diat.* p. 53, t. 17. f. 155.

*Hab.* In warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1177.—In stream, Wotten Waven, Dominica. No. 1248.

*63. N. ELLIPTICA, *Kuetz. Bacill.* p. 98, t. 30. f. 55; *Van Heurck, l. c.* p. 201, t. 4. f. 156.

*Hab.* On leaves of trees and in stream, Wotten Waven, Dominica. Nos. 1240 and 1249.

*64. N. CONTENTA, *Grun. in Van Heurck, Atlas*, t. 14. f. 31*, sub. n. *N. trinodis*; *Van Heurck, Diatom.* (Engl. transl.) p. 230, t. 5. f. 239.

Var. BICEPS, *Van Heurck, l. c.* p. 230, t. 5. f. 240.

*Hab.* On leaves of trees, Wotten Waven, Dominica: very abundant. No. 1240.—Also scarce in stream, Wotten Waven, Dominica. No. 1249.

65. VANHEURCKIA RHOMBOIDES, *Bréb.*; *Van Heurck, Diatom.* (Engl. transl.) p. 240, t. 5. f. 249.—Frustulia rhomboides, *De Toni, Sylloge Algar.* ii. p. 227.—Navicula rhomboides, *Ehrenb.*; *W. Sm. Brit. Diat.* i. p. 46, t. 16. f. 129.

*Hab.* On bank, near Roseau Lake (2700 ft.), Dominica. No. 1180.—In stream, Wotten Waven, Dominica. Nos. 1248 and 1249.

Var. SAXONICA.—Frustulia saxonica, *Rabenh.* Navicula crassinervia, *Bréb. in W. Sm. Brit. Diat.* i. p. 47, t. 31. f. 271.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.—On roadside near Roseau Lake (2700 ft.), Dominica. No. 1160.—On leaves in warm stream and on bank, road to Roseau Lake (2500–2700 ft.), Dominica. Nos. 1178 and 1222.—Head of Castle Bruce River, Dominica. No. 1484.

*66. VANHEURCKIA VULGARIS, *Van Heurck, Diatom.* (Engl. transl.) p. 240, t. 5. f. 252.—Colletonema vulgaris, *Thwaites.*

*Hab.* In small stream, Roseau Valley, Dominica. No. 1176.—In stream, Wotten Waven, Dominica. Nos. 1248 and 1249.

### Fam. GOMPHONEMEÆ.

*67. GOMPHONEMA GRACILE, *Ehrenb.*; *Van Heurck, l. c.* p. 272, t. 7. f. 309.

Var. DICHOTOMUM, *Van Heurck, l. c.* p. 273, t. 7. f. 310.—G. dichotomum, *W. Sm.*

*Hab.* In warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1177.

*68. G. ANGUSTATUM, *Kuetz. Bacill.* p. 83, t. 8. f. 4.

*Hab.* In warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1177.—In stream, Wotten Waven, Dominica. No. 1248.

*69. G. OLIVACEUM, *Kuetz. l. c.* p. 85, t. 7. ff. 13, 15.

*Hab.* In small stream, Roseau Valley, Dominica. No. 1176.

70. G. TENELLUM, *Kuetz.*; *W. Sm. Brit. Diat.* i. p. 80, t. 29. f. 243.

*Hab.* In stream, Wotten Waven, Dominica. No. 1249.

### Fam. ACHNANTHEÆ.

*71. ACHNANTHES LINEARIS, *Grun.*—Achnanthidium lineare, *W. Sm. Brit. Diat.* ii. p. 31, t. 61. f. 381.

*Hab.* On banks, Emsol, Roseau, Dominica. No. 986.—In small stream, Roseau Valley, Dominica. No. 1176.

*72. A. LANCEOLATA, *Grun.*—Achnanthidium lanceolatum, *Bréb. in Kuetz. Spec. Algar.* p. 54.

*Hab.* Among *Nostoc muscorum*, Agardh, on sides of road, Fort Charlotte, St. Vincent. No. 203.—On leaves of trees, Wotten Waven, Dominica. No. 1240.

### Fam. COCCONEIDEÆ.

*73. COCCONEIS PEDICULUS, *Ehrenb.*; *Kuetz. Bacill.* t. 5. f. ix. 1; *W. Sm. Brit. Diat.* i. p. 21, t. 3. f. 31.

*Hab.* Attached to *Lyngbya majuscula*, Harv., in shallow bays, Anguilla. No. 20.

### Ord. PSEUDO-RAPHIDIEÆ.

#### Fam. EPITHEMIEÆ.

*74. EPITHEMIA GIBBERULA, *Kuetz. Bacill.* t. 30. f. 3*; *Van Heurck*, *Diatom.* (Engl. transl.) p. 297, t. 30. f. 825.

*Hab.* On sides of road, Fort Charlotte, St. Vincent. No. 203. —In warm stream, road to Roseau Lake (2500 ft.), Dominica. Nos. 1177 and 1178.—On bank, road to Lake, Dominica. No. 1222.—Head of Castle Bruce River, Dominica. No. 1484.—On rocks, Hampstead Valley, Dominica (850 ft.). No. 2171.

75. EUNOTIA GRACILIS, *Rabenh. Flor. Europ. Algar.* i. p. 72.—Himantidium gracile, *Ehrenb.*; *W. Sm. Brit. Diat.* ii. p. 14, t. 33. f. 285.

*Hab.* On banks, Morne Micotrin, Dominica. No. 1109.—On roadside, on bank and on trees in woods round Roseau Lake, Dominica (2700 ft.). Nos. 1160, 1161, and 1164.—On leaves in warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1178.—On rocks, Castle Bruce River, Dominica. No. 1697. —On rocks, Hampstead Valley, Dominica. No. 2171.

*76. E. PECTINALIS, *Rabenh. Flor. Europ. Algar.* i. p. 73.—Himantidium pectinale, *Kuetz. Bacill.* t. 16. f. 2.

*Hab.* In warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1177.—On ground, crater of Grande Soufrière (2000–3000 ft.), Dominica. No. 1835.

*77. E. VENERIS, *Kuetz. Bacill.* p. 40, t. 30. f. 7.—E. incisa, *Greg.*

*Hab.* In warm stream, road to Roseau Lake (2500 ft.), Dominica. Nos. 1177 and 1178.

*78. E. LUNARIS, *Grun.*—Synedra lunaris, *Ehrenb.*; *W. Sm. Brit. Diat.* i. p. 69, t. 11. f. 82.

*Hab.* On leaves in warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1178.—On ground, crater of Grande Soufrière, Dominica (2000–3000 ft.). No. 1835.

### Fam. SYNEDREÆ.

*79. SYNEDRA PULCHELLA, *Kuetz. Bacill.* p. 68, t. 29. f. 87.

*Hab.* In small stream, Roseau Valley, Dominica. No. 1176.—In stream, Wotten Waven, Dominica. No. 1249.

*80. S. RADIANS, *Grun.*; *Van Heurck, Diatom.* (Engl. transl.) p. 312, t. 10. f. 423.

*Hab.* In stream, Wotten Waven, Dominica. No. 1249.

### Fam. DIATOMEÆ.

*81. DENTICULA TENUIS, *Kuetz. Bacill.* t. 18. f. 8.

Var. INFLATA, *Van Heurck, Diatom.* (Engl. transl.) p. 352, t. 11. f. 462.—D. inflata, *W. Sm.*

*Hab.* In small stream, Roseau Valley, Dominica. No. 1176.—Head of Castle Bruce River, Dominica. No. 1484.

### Fam. NITZSCHIEÆ.

82. NITZSCHIA DISSIPATA, *Grun.*; *Van Heurck, Diatom.* (Engl. transl.) p. 394, t. 16. f. 525. (? N. minutissima, *W. Sm. Brit. Diat.* p. 41, t. 13. f. 107.)

*Hab.* On leaves in warm stream, road to Roseau Lake, Dominica (2500 ft.). No. 1178.—On leaves, Wotten Waven, Dominica. No. 1240.—On ground, crater of Grande Soufrière (2000–3000 ft.), Dominica. No. 1832.

*83. N. OBTUSA, *W. Sm. Brit. Diat.* i. p. 39, t. 13. f. 109.

Var. NANA, *Grun.*; *Van Heurck, Diatom.* (Engl. transl.) p. 398, t. 16. f. 539.

*Hab.* On bank, at roadside, Emsol, near Roseau, Dominica. No. 983.

84. N. LINEARIS, *W. Sm. Brit. Diat.* i. p. 39, t. 13. f. 110.

*Hab.* In small stream, Roseau Valley, Dominica. No. 1176.

Var. TENUIS, *Grun.*—N. tenuis, *W. Sm.*

*Hab.* On ground, crater of Grande Soufrière (2000–3000 ft.), Dominica. Nos. 1832 and 1835.

*85. N. COMMUNIS, *Rabenh.*; *Flor. Europ. Algar.* i. p. 159.

*Hab.* Among *Nostoc muscorum*, Agardh, on sides of road, Fort Charlotte, St. Vincent. No. 203.—On bank, at roadside, Emsol, near Roseau, Dominica. No. 983.

### Ord. CRYPTO-RAPHIDIEÆ.

### Fam. MELOSIREÆ.

*86. MELOSIRA VARIANS, *Agardh*; *W. Sm. Brit. Diat.* ii. p. 57, t. 51. f. 332.

*Hab.* In warm stream, road to Roseau Lake (2500 ft.), Dominica. No. 1177.

### Fam. BIDDULPHIEÆ.

*87. TERPSINOË MUSICA, *Ehrenb.*; *Van Heurck, Diatom.* (Engl. transl.) p. 452, cum fig. xylogr. 176.

*Hab.* In cold and warm streams, road to Roseau Lake (2500 ft.), Dominica: very abundant. Nos. 1176 and 1177.

This species is highly interesting as most of the genera of this family are notably marine.

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## On *Carex Wahlenbergiana*, Boott.

By C. B. CLARKE, F.R.S., F.L.S.

[Read 6th April, 1899.]

1. CAREX WAHLENBERGIANA, *Boott, Carex*, ii. (1860) p. 101, t. 301.—Foliorum pagina superior, levis, 19-costata; costæ validæ, leves striis paucis tenuibus interjectis. Panicula 3–6 dm. longa, 5–10 cm. lata; paniculæ partiales inferiores oblongæ, nec pyramidales; spicæ densiuscule sitæ, nec congestæ, ferrugineo-bruneæ, rarius pallide bruneæ subviridescentes (var. *pallida*, Boott MS.). Glumæ unicolores, bruneæ, striis numerosis obscuris, glabræ in carinâ leves (cf. var. $\beta$) vel apicem versus paullo scabræ. Utriculus (rostro incluso) 4 mm. longus, ellipsoideo-lanceolatus, rectus rarius paullo curvatus, plano-convexus, in facie planâ 5–7-striatus, convexâ 9–11-striatus, in marginibus (sæpe usque ad basin fere) minute scaber, glaber (cf. var. $\beta$) in rostrum sensim attenuatus, luteo-brunescens, unicolor; rostrum cum ½ parte utriculi subæquilongum, latiusculum, leve, dentibus 2 majusculis, lanceolatis, paullo scabris subpatulis. Nux oblongo-obovoidea, acute triquetra fere sessilis.—Boeck. in Linnæa, xl. (1876) p. 357 partim, *i. e.* nucis descr. emend. et Boott t. 304 excl.; Baker! Fl. Maurit. p. 427.

*Carex indica*, Wahlenb. in Kongl. Vet. Acad. Stockh. xxiv. (1803) p. 149; Schkuhr, Riedgr. ii. (1806) p. 40, t. Qqqq. fig. 206; Kunth, Enum. ii. p. 509 partim; *non* Linn.

*C. Commersoniana*, A. Rich. MS. e Spach! (exemplum in herb. Boott propr. a Spach communicatum).

*Hab.* in Bourbon: Boivin n. β 994 in herb. Boott propr. [Boott t. 301 = *Wahlenbergiana type*]; Boivin n. 10 ex parte; Boivin n. 9 (var. ε. *pallida*, Boott MS.! In Mauritius: Telfair (in herb. Hook. propr.).

C. WAHLENBERGIANA, varr. β, γ, ε, *Boott*! *Carex*, ii. (1860) p. 101, tt. 302, 303, 305.—Spicæ magis fasciculatæ, suberectæ. Glumæ fœmineæ in dorso superiore ob pilos minutos albos erectos scabræ. Utriculus in parte superiore vel fere usque ad basin pilosæ.

*C. crinigera*, var. β. *minor*, Boott! Carex, ii. (1860) p. 102, t. 309.

*C. ramosa*, Boeck. in Linnæa, xl. (1876) p. 359 partim.

*Hab.* in Bourbon: Richard, in herb. Boott propr. a Spach communicata [= Boott t. 302]; Commerson, in herb. Boott propr. a Spach communicata [= Boott t. 303]; Bayley Balfour (in herb. Kew). In Mauritius: Gardner, in herb. Kew, a manu Boottii "*C. Boryana*, Schk.?" inscripta.

It does not seem possible to draw a line between the *C. Wahlenbergiana* α (with glabrous glumes and utricles) and its varr. β, γ, Boott (with scabrous-pilose glumes and utricles). It can be seen by the plates that *C. cornigera* β. *minor*, t. 309, does not differ at all from *C. Wahlenbergiana*, varr. β, γ, Boott tt. 302, 303; the plants were all from one locality, and might well be one collection.

Taking the species as widely as this, it becomes the more difficult to separate it from many others, especially from the Himalayan *C. condensata*, Nees: in this the spikelets are rather smaller, the inflorescence denser, less interrupted, and the leaves do not match under the microscope; but I cannot state any difference whatever in the female glumes and utricles. As to the South-east African *C. condensata* (C. B. Clarke in Dyer, Fl. Cap. vii. p. 305), it is nearer the Himalayan *C. condensata* than it is to *C. Wahlenbergiana*; it probably should be esteemed a distinct species, unless a large reduction should be made (as is quite feasible) in this group of *Carex*.

Boeckeler's description of the long-stalked nut applies to the next species.

2. CAREX STEUDNERI, *Boeck.*! *in Linnæa*, xl. (1876) p. 364.—Utriculi 7–8 mm. longi, lineari-lanceolati, trigoni, pilosi. Nux lineari-oblonga, in stipite lineari conspicue sustenta.

*Carex Wahlenbergiana*, var. δ, Boott! Carex, ii. (1860) p. 101, t. 304; Boeck. in Linnæa, xl. (1876) p. 357 partim.

*Hab.* in Abyssinia: Tigré, Schimper, n. 1559 (in hb. Kew); Mt. Silhe alt. 3000 metr., Schimper n. 545 (in herb. Boott).

This species is very strongly characterized by the long narrow utricle, and differs much from *C. Wahlenbergiana* in habit and in minor characters, as is well shown by the figures of Boott and the description of Boeckeler.

3. CAREX RENSCHIANA, *Boeck.*! *in Engl. Jahrb.* v. (1884) p. 515.—Folia angusta, in paginâ superiore 7–11-striata, levia vel in costâ mediâ leviter scabra. Inflorescentia 3–5 dm. longa, 5 cm. lata; paniculæ partiales inferiores, oblongæ nec pyramidales; spicæ laxiuscule sitæ castaneo-rubræ. Glumæ unicolores, bruneo-rubræ aut castaneæ, glabræ, leves. Utriculus (rostro incluso) 3–4 mm. longo, ellipsoideus, trigonus, in rostrum subito angustatus ibique valide curvatus, plano-convexus, in facie planâ 3–5-nervis, convexâ 5–7-nervis (striis imperfectis interjectis), levis, glaber, viridis sanguineo-maculatus; rostrum cum utriculo proprio fere æquilongum, leve, lineare, apice breviter 2-dentatum. Nux oblongo-obovoidea, trigona, pro utriculo magna, sessilis.

*Hab.* in Central Madagascar: Ost-Imerina, Andrangvloaka; Hildebrandt, nn. 3746, 3752.

4. CAREX HÆMATOSACCUS, sp. nova. Folia 19–27-costata, levia vel juniora sparsim microscopice pilosa; costæ validæ, approximatæ. Utriculus (rostro incluso) 3–4 mm. longus, trigonus, ellipsoideo-lanceolatus, rectus; rostrum cum ½ parte utriculi subæquilongum, lineari-conicum, minute scabrum aut scabro-hispidulum, dentibus 2 majusculis lanceolatis; ceteroquin ut *C. Renschiana*, Boeck.

*Carex Wahlenbergiana*, Boott MS. in herb. propr. et in herb. Kew.

*Hab.* in Madagascar: between Tamatave and Antananarivo, alt. 1250 metr. (Mbatomanga), Meller (in herbb. Boott propr., Kew, a manu Boottii "*C. Wahlenbergiana*" inscripta); Central Madagascar, Baron n. 1085 (a J. G. Baker, "*C. bengalensis*, Roxb." inscripta); Ivophinsornitra, Major n. 89.

This may be arranged as a var. of *Carex Renschiana*, Boeck.; the straight, much shorter beaks of the utricles give it a different aspect.

5. CAREX RAMOSA, *Schkuhr*, *Riedgr.* ii. (1806) p. 40, t. Pppp. fig. 204.—Panicula magna, polystachya, ferrugineo-brunea; paniculæ partiales compositæ, subpyramidate, laxæ. Glumæ utriculi densius pilosuli; ceteroquin ut *Carex Wahlenbergiana*, Boott var. β.—Kunth, Enum. ii. p. 507 partim (*i. e.* plantæ mascarenicæ); Boeck. in Linnæa, xl. (1876) p. 359 [Boott tab. 309 excl.]; Baker, Fl. Maurit. p. 427; *non* Boott, t. 322.

*C. crinigera*, Boott, Carex, ii. (1860) p. 102, tt. 306–308.

*Hab.* in Bourbon, Richard, n. 7 in herb. Boott. (i. e. *C. crinigera*, Boott, tt. 306–308]; Mauritius, Bojer (in herb. Kew), Du Petit Thouars (in herb. Boott, utriculi).

Boeckeler is right, I think, in regarding *C. crinigera*, Boott type as exactly = *C. ramosa*, Schkuhr. But the line between this and *C. Wahlenbergiana* varr. β, γ, Boott, is very fine.

6. CAREX CHLOROSACCUS, sp. nova.—Folia 5 mm. lata, levia, 15-striata. Panicula 1–2 dm. longa 3–4 cm. lata (in exemplo Johnstoni magis evoluta); paniculæ partiales inferiores oblongæ, strictæ; spicæ approximatæ, vix congestæ, albo-virides. Glumæ fœmineæ utriculis multo breviores, ovatæ, acutæ, mucronatæ, leves, glabræ, in dorso viridi-3–5-nerviæ, in lateribus albæ. Utriculus (rostro incluso) 4–5 mm. longus, ellipsoideo-lanceolatus, trigonus, unicolor viridis, levis, in facie planâ 3-nervis, convexâ 5–7-nervis, rectus, apice subito angustatus obliquus; rostrum cum ½–⅔ parte utriculi proprii subæquilongum, lineare, leve, dentibus 2 lanceolatis modicis. Nux anguste obovoidea, trigona, fere sessilis.

*Carex Wahlenbergiana*, Boott! in Journ. Linn. Soc., Bot. vii. (1864) p. 225; Engl. Hochgebirgsfl. Trop. Afr. p. 152; K. Schum. in Engl. Pfl. Ost-Afr. C. (1895) p. 129 partim; C. B. Clarke in Dur. et Schinz, Fl. Afr. v. (1895) p. 691 partim. *C. ramosa*, K. Schum. in Engl. Pfl. Ost-Afr. C. (1895) p. 129 partim.

*Hab.* in Fernando Po: Clarence Peak, alt. 2500 metr., G.

Mann, n. 653 in herb. Kew. Kilimanjaro, alt. 2000–3000 metr., H. H. Johnston; Marangu, alt. 2250 metr., Volkens n. 1274.

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Vol. XXVI. is still in course of issue, and the Parts already published are as follows:—

Vol. XXVI., Nos. 173–177.

[Nos. 178–180 are reserved for the continuation of Messrs. Forbes and Hemsley's 'Index Floræ Sinensis.' A further instalment of the MS. has now been received, and is in the press; the authors hope to complete the volume at an early date.]

Vol. XXVII., Nos. 181–188. (Complete.)

Vol. XXVIII., Nos. 189–196. (Complete.)

Vol. XXIX., Nos. 197–204. (Complete.)

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# THE JOURNAL

OF

# THE LINNEAN SOCIETY.

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# THE BOTANY OF THE CEYLON PATANAS. By HENRY HAROLD WELCH PEARSON, B.A., 'Frank Smart' Student of Botany at Gonville and Caius College, Cambridge. (Communicated by Prof. H. MARSHALL WARD, F.R.S., F.L.S.)

[Read 20th April, 1899.]

(With MAP.)

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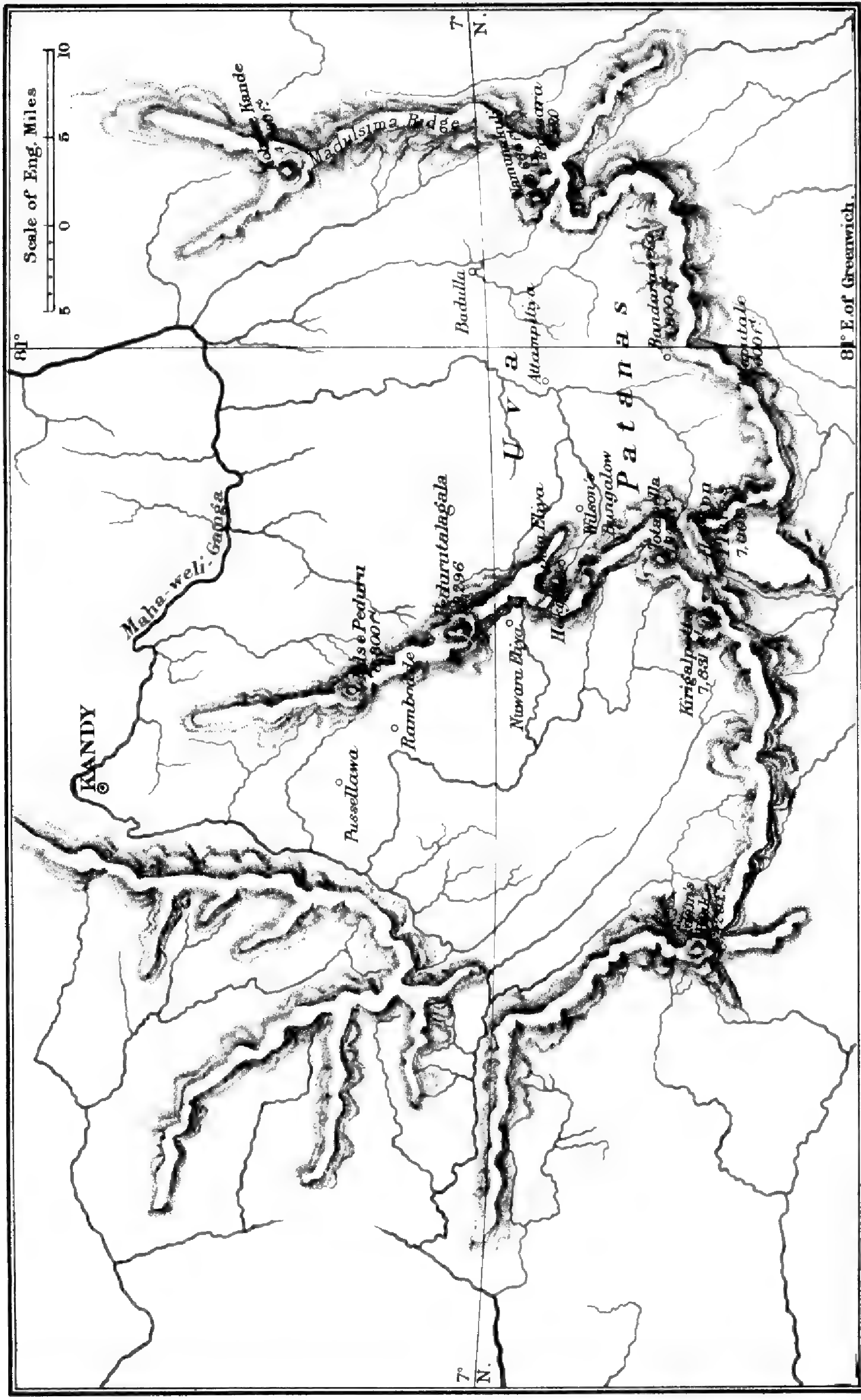
## *Introduction.*

OBSERVATIONS upon the Flora of the Patanas of the Ceylon Mountains, an account of which is contained in this paper, were made during a visit to Ceylon in the latter half of 1897. The purpose of these investigations was to ascertain (i) the probable causes which have led to the development of these remarkable savannah-like expanses in an otherwise forest-covered country; and (ii) to what extent the vegetation of the patanas shows adaptations to the peculiar œcological (1) factors under the influence of which it has been selected.

Attempts to settle the first question will be found in these pages. The second problem is at present not fully treated of; that portion of it, however, which is not here dealt with, and which involves an anatomical examination of many of the patana-plants, will receive attention in a paper which will follow this as soon as possible. Owing to some unaccountable delay in the transmission of my collections, and to the pressure of other work since they arrived, these results have already been so long


Scale of Eng. Miles
5
0
5
10
Kande
Madulsima Ridge
Namunakula
Badulla
Uva
Attampitiya
Patanas
Bandarawela
Haputale
Wilson's Bungalow
Pedurutalagala
8,296
Nuwara Eliya
Hakgala
Totapella
Kirigalpotta
7,831
7,000
Pidurutalagala
Rambodde
Pussellawa
KANDY
Maha-weli-Ganga
7° N.
81°
81° E. of Greenwich.
Stanford's Geog! Estab! London

THE CENTRAL PLATEAU OF CEYLON

delayed, that it seems desirable to publish the first part now, rather than wait until the whole is completed.

My stay in the Island was unavoidably limited to a period of rather less than six months, the greater part of which was during the prevalence of the S.W. monsoon. I was, therefore, unable to observe the full effect of the N.E. monsoon upon the patanas, which was the more unfortunate since this monsoon supplies the greater part of their annual rainfall, and the period of its duration is, therefore, that of the greatest vegetative activity of the district. The collection, of which a list is given at the end of this paper, is as nearly as possible representative of the plants which appear on the patanas during the S.W. monsoon and in the first six weeks of the N.E. monsoon.

## *Topography.*

The patanas are grassy slopes and plains of considerable extent, occurring in the central mountain-group at all elevations above 2000 feet. Their main development is to the east of a high ridge which traverses the central plateau of the Island. The mountains form a group near the centre of the Island, rising very abruptly from the low country to the east and south (see Map). The western boundary of the group is formed by an almost uninterrupted ridge which runs southward from the neighbourhood of Kandy (2000 ft.) to Adam's Peak (7420 ft.). On the western side of this ridge, successive ranges of low hills extend almost to the coast. From Adam's Peak, the ridge takes an easterly direction through Kirigalpotta (7831 ft.), Horton Plains (7000 ft.), and Haputale (4100 ft.), forming the southern boundary of the plateau. From Haputale the trend becomes north-easterly to Namunukuli (6680 ft.), and then northerly to Kohane-Kande (4900 ft.). These ridges, forming the boundaries of the central plateau on the west, south, and east, have approximately the form of three sides of a square, about 50 miles in the side. On the north the hills are low and scattered (not indicated on the map), and among them are the main outlets of the streams which unite to form the Mahaweli-ganga *, which carries to the east coast almost the entire drainage of the plateau.

---

* "Mahaweli-ganga," "the great sand river," a name expressive of the large amount of detritus which its waters carry.

The loftiest range of the Island runs through the plateau in a general N.N.W. direction from Kirigalpotta (7831 ft.), through Totapella (7740 ft.), Pedurutalagala (the highest mountain in the island, 8296 ft.), and False Peduru (6782 ft.) to the neighbourhood of Kandy, sending out numerous important lateral spurs. The situation of this range, as will be seen later, is of supreme importance in determining the climatic conditions which prevail on either side of it, and which have a very striking effect upon the vegetation. On the western slopes of this ridge, from the summit downwards, the land was originally completely forest-clad. Except at higher elevations this forest has, to a very large extent, disappeared before the invasion of coffee and tea plantations; and it is now difficult to realize what the country was like before the destruction of so much of its forest took place. Where still standing, the forest consists of small hard-wooded, slow-glowing trees with small erect coriaceous leaves, belonging principally to species of *Eugenia*, *Calophyllum*, *Litsea*, *Actinodaphne*, *Gordonia*, *Elæocarpus*, *Symplocos* (2), etc., with a dense shrubby undergrowth of *Strobilanthes*, dwarf Bamboos, Begonias, etc.

Very different, however, is the aspect of the country on the eastern side of the ridge. The descent is not so steep, nor are the valleys so deep as on the western side. On this side of the ridge, a forest of the western type is found only upon the lateral spurs which extend for some distance in an easterly direction; in the valleys between them and on the lower undulating plains beyond, for a distance of 25 miles, there is a striking absence of forest growth, and the country presents all the characters of a savannah. This expanse—known as the "Uva Patana-lands"*—terminates in the south in the sharp ridge of Haputale (4400 ft.); while from near its eastern boundary rises the forest-covered mass of Namunukuli (6680 ft.). This district comprises by far the larger area of the patana-lands, and in it the observations recorded here were made. Minor developments of the same type of vegetation are found in other parts of the mountain-system; and, although a few of these were examined, the results are not mentioned, except in so far as may be necessary for comparison with the larger and more typical area.

---

* Being, for the most part, in the province of Uva.

### *Flora of the Uva Patanas.*

The Uva Patana country is an undulating plain rising from 2000 feet in the east to 4500 feet in the west and south. Although, as will be seen later, this area receives no inconsiderable rainfall, it is nevertheless for the greater portion of the year dry and parched. The flora is poor, its main constituents being several species of coarse wiry grasses, belonging principally to the genera *Panicum*, *Paspalum*, *Sporobolus*, *Aristida*, *Chloris*, *Andropogon*, *Imperata*, etc., species of which are characteristic of Savannahs (**3**)* and Pampas (**4**) in other parts of the world. The tree-vegetation of the Uva patanas is almost entirely represented by comparatively few individuals belonging to two species—*Careya arborea*, Roxb., and *Phyllanthus Emblica*, Linn. The first is a small umbrella-shaped Myrtaceous tree, with thick glabrous leaves, bearing considerable resemblance to an oak; this tree is so characteristic of the patanas between 3000 feet and 4500 feet, that it is usually known as the "Patana Oak." The second is especially characteristic of the patanas at and below 3000 feet; its leaves are deciduous during the dry season (**5**). These two species occur together in abundance on the so-called "Talawa-patanas"† at about 3000 feet, giving to the country an orchard-like appearance (**6**). In situations which are favourable to the accumulation of soil, which, as will be seen, is practically absent over a great part of the area, numerous small arborescent species have established themselves. These are species which, for the most part, are characteristic of the dry-country forest to the east (*v. infra*): e. g., *Lasiosiphon eriocephalus*, *Dodonæa viscosa*, *Myrsine capitellata*, *Jasminum angustifolium*, *Glochidion montanum*, *Breynia patens*, etc. Others, however, are equally characteristic of the wet-country forest to the west: viz., *Heptapleurum stellatum*, *Canthium* sp., *Microglossa zeylanica*, *Embelia viridiflora*, *Glochidion* sp., *Osbeckia* sp., etc. Others, again, form a more marked feature of the patanas themselves: these include *Knoxia platycarpa*, *Vernonia Wightiana*,

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* Junghuhn states that in Java and Sumatra the destruction of the forests has been followed by the appearance of savannahs whose vegetation consists almost entirely of the grass *Imperata arundinacea* ("Alang") and a few scattered trees of *Phyllanthus Emblica*: *vide* Grisebach, 'La Végétation du Monde' (French trans. by Tchihatchef), Paris, 1876, vol. ii. p. 56.

† *i. e.* "tree-patanas."

*Atylosia Candollei, Osyris arborea, Woodfordia floribunda*, etc. Among the smaller plants which are widely represented on the patanas below 4500 feet, are several species of Leguminosæ, Compositæ, Labiatæ, and a few Cyperaceæ.

### *Flora of the Patanas above* 4500 *feet.*

On the south, the Uva patanas abut against the wet-zone forest at about 4500 feet. On the south-west and west, however, wide and extensive tongues of patana-vegetation protrude into the forest on the eastern slopes of the central ridge, and even in places cross the summit of the ridge: thus, extensive patanas are found on Horton Plains (7000 ft.), on the eastern slopes of Totapella, up the Hakgala valley, and across the ridge as far as Nuwara Eliya. These localities enjoy a heavy and continuous rainfall, and here a patana-vegetation flourishes upon a soil which is rich in humus. Here, as on the Uva patanas, the Gramineæ constitute the bulk of the flora, and belong, for the most part, to the same genera as in that region; their growth is, however, more luxuriant. They have a marked tufted habit*, which on the slopes is often so pronounced as to render walking difficult; above 6000 feet, however, they grow much more compactly and form a coarse turf. Species of Cyperaceæ and Eriocaulonaceæ are very abundant above 5000 feet, being especially characteristic of swampy places. The arborescent flora is represented by a single species, *Rhododendron arboreum*, Sm., var. *nilagiricum*; this tree has a dwarfed and gnarled habit, especially at lower elevations, where it is exposed to the blighting effect of the S.W. gales: this habit was also noticed by Schimper in the case of trees growing in an exposed situation on Pedurutalagala (**7**). On Horton Plains, where this species is very abundant, the growth is more luxuriant; in this locality the branches support long trailing masses of *Usnea barbata*. Above 5000 feet, the composition of the flora changes considerably and becomes almost temperate, and includes species of such characteristic temperate and subalpine genera as *Anemone, Thalictrum, Ranunculus, Berberis, Hypericum, Rubus, Potentilla, Alchemilla, Agrimonia, Valeriana, Dipsacus, Campanula, Gentiana*, etc. Many of the Uva shrubs are as well or even better represented here than at lower elevations: e.g., *Knoxia platycarpa*, *Vernonia Wightiana*, *Atylosia Candollei*, *Osbeckia* sp., etc. Other shrubs which hardly occur below 5000 feet are *Hedyotis Lawsoniæ*, *Hypericum mysorense*, *Blumea* sp., *Rubus* sp., etc. Several species of ground Orchids are almost confined to elevations above 5000 feet; and hardly less so are two or three species of *Exacum*, whose bright blue flowers are the chief ornament of the patanas above 5000 feet; while species of *Wahlenbergia*, *Crotalaria*, *Cassia*, and *Anaphalis* have a wider range.

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* The grasses of the Campos have a similar habit; Warming (**1**), p. 263.

### *The Western Boundary of the Patanas.*

Where the patanas come into contact with the western forest, the boundary lines are remarkably sharp and abrupt, though quite irregular and in no way related to any physical features of the land. The ordinary forest-growth is found within 3 to 6 feet of the normal patana-vegetation, only a very narrow belt intervening. The plants composing this intermediate belt consist principally of stunted forest-trees and such of the forest undershrubs as are found also on the patanas, as well as other shrubby species which are more particularly characteristic of the patanas; with these are mingled comparatively few of the coarser patana-grasses, conspicuous among which is the tall aromatic "Mana"-grass (*Andropogon Nardus*). Occasionally the belt is almost entirely composed of a single shrubby species, such as *Hedyotis Lawsoniæ* or *Knoxia platycarpa*. The forest-edge thus presents a sloping-wall of foliage which rises abruptly from the low grassy vegetation of the patanas to the height of the forest-trees.

The first impression gained from an examination of the flora of this narrow intervening belt, is that the causes which have determined its composition are artificial rather than natural. It differs markedly in its constitution from the intermediate flora found between the American prairies and the adjoining forest, which, if Macmillan's view of the latter is correct (**8**), consists of "species weaker than the characteristic plants of either formation." He states that, in the struggle for existence, the weaker species of the prairie and the forest respectively are crowded to the common periphery of the two formations, and there mingle, thus constituting a flora intermediate between the two which it separates.

The constituents of the narrow belt separating the forest from the patana are, however, far from being the weaker species of either formation, whether they are considered numerically or from the point of view of adaptation; they are hardy perennials, for the most part shrubby or arborescent, whose characters in no way suggest that they have been crowded out from either flora by natural causes. The primary factor in their selection has undoubtedly been the recurrent grass-fires which periodically lay waste the patana-areas, and to which further reference will be made.

Small areas of forest, still connected by forest-growth with the main development, or even completely isolated from it, extend into the patanas; an isolated patch of forest frequently clothes the crown of a hill whose slopes are occupied by patana. And similarly, though perhaps less commonly, isolated patches of patana whose area may vary from a few hundred square yards to several acres are found completely surrounded by forest.

### *The Eastern Boundary of the Patanas.*

In the east, the patanas pass gradually into an open park-like forest consisting of low xerophytic trees and an undergrowth of grass*. This change occurs on either side of Madulsima ridge. The features of the Ceylon "Park-country" forest are thus described (**9**): "This is a type of forest found at the foot of the Himalayas, having grass as undergrowth instead of dense brushwood as in other forests of the Island. The flora of these forests is strikingly similar to that of the sub-Himalayan forest, some of the species being rarely found elsewhere in the Island. Such are *Anogeissus latifolia*, *Diospyros melanoxylon*, *Terminalia Chebula*, and *Pterocarpus Marsupium*.... Their associates are also essentially Indian species, such as *Terminalia Bellerica*, *Phyllanthus Emblica*, *Careya arborea*; while the most common *Phyllanthus* is very like the *Glochidion velutinum* found in the sub-Himalayan forests."

The grasses constituting the undergrowth are principally *Anthistiria arguens*, *Andropogon filipendulus*, *A. caricosus*, *A. serratus*, *Ophiurus perforatus*, *Aristida* sp., and *Chrysopogon teneantha* (?) (**10**).

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* Such a forest has been termed "Savannenwald" by Schimper, 'Pflanzen Geographie,' p. 282.

### *Area of the Patanas.*

The area of the patanas is not known with any degree of accuracy. Tennent almost certainly exaggerates when he says "the extent of this patana-land is enormous in Ceylon, amounting to millions of acres" (**11**). The area of the district under consideration may be taken roughly as 300 square miles.

### *Theories to account for the Origin of the Patanas.*

The existence of extensive, comparatively barren, patana-areas in the midst of the luxuriant sub-tropical growth of the montane region, and, more particularly, the manner in which they abut upon the boundaries of the western forests, have attracted the attention of many observers. To account for the existence in such close proximity of two floras so widely different, three theories have been advanced.

### (i.) *Trimen's Theory.*

Trimen, in the paper referred to (**12**), does not attempt a general explanation of the causes which have been active in the selection of the forms which now compose the flora of the patanas. He gives, however, his opinion respecting the maintenance of a definite line of separation between the western boundary of the patanas and the forest. He says that "in the course of vast ages a perfect equilibrium between the two floras (*i. e.* patana and forest) has been arrived at, so that now, neither can encroach on the other: the patana-plants are unable to exist in the dense shady forest, whilst the seeds of the forest-trees never get a chance even of germination in the closely-occupied grass-land. So far as can be observed, this balance is now maintained without change." It must, however, be impossible that a line of separation such as is here indicated, not only definite but also fixed, could be maintained in nature, unless it were determined by some sharp physical barrier, impassable to the plants on either side of it. That such a barrier is wanting here is obvious to anyone who follows the forest-edge for a short distance. But, apart from this theoretical consideration, it is by no means difficult to find seedlings of forest-trees establishing themselves among the patana-grasses; and, further, not a few of the characteristic patana shrubs and herbs are commonly found in the dense shady forest. The experience of foresters and planters shows that where the patanas in the vicinity of the western forest are protected from grass-fires, the forest slowly establishes itself upon the patana; and it is a well-known fact that, unless these fires are prevented, the patana encroaches upon the forest. We must then conclude that the balance between the two floras is not "now maintained without change" as Trimen believed, though such change as does take place is, for reasons which will be indicated later, so gradual that it may be easily overlooked.

### (ii.) *Abbay's Theory.*

Abbay, in a letter to 'Nature' **(13)**, gives the results of his examination of a small area of patana in the valley leading from Pussellawa to Rambodde, situated about 6 miles N.W. of Nuwara Eliya, and on the western side of the central range. He finds there an outcropping band of "half-formed quartzite" which disintegrates into "little else than a quartz-sand impregnated with iron, and entirely incapable of supporting the usual forest-vegetation with which the district, except in this particular spot, abounds." And to this alone he attributes the development of patana-vegetation on the lower slopes of the valley. He further states that he was "informed that the same quartzite formation occurs in the Uva patana district;" and he, therefore, believes it probable that all the other patanas, especially the larger ones, "owe their origin to the cropping out of this quartzite band." There is no further evidence to hand with regard to the structure of the Pussellawa and Rambodde valley, and presumably Abbay's account of it is correct; but whether he is justified in attributing the presence of a patana-flora on the lower slopes of the valley to its geological structure alone, is perhaps open to question. He is certainly incorrect in assuming that the same geological structure in Uva will also explain the existence of the patanas over a large part of that province. The occurrence of quartzite on the Uva patanas was denied by Heelis **(14)**, who makes the comprehensive statement that "in the Uva patana district the rock is limestone," a generalization which is, however, far from being correct. There is in Uva a small local development of limestone only, but over by far the greater part of the patana-area the underlying rock is gneiss, whose decomposition-products do not materially differ from those formed in districts covered by a luxuriant montane forest; except in so far as the decomposition of the hard rock may proceed more quickly under the moister conditions which the presence of forest-growth implies. Examination of specimens of soil, subsoil, and bed-rock from various parts of the Uva patana-district have yielded no suggestion of the presence of a quartzite-formation *. Therefore, although the outcropping of the band of quartzite may be, to some extent at least, responsible for the occurrence of patana where it was observed by Abbay, this solution of the difficulty will not hold generally, and is certainly not a true one for the great patana-area of Uva.

### (iii.) *The Grass-fire Theory.*

Reference has already been made to the grass-fires which appear periodically on the patanas, and their importance will now be considered. The patana-grasses are very coarse and wiry, and in their adult condition are unpalatable to cattle, numerous herds of which graze in the district. It has therefore been the graziers' custom, probably from time immemorial—and, in spite of government regulations against it, is so still—to set fire to the grass at least annually, before the bursting of the N.E. monsoon, in order to provide a young fresh growth during the monsoon rains, upon which the cattle will feed. Early in October these fires can be seen blazing in all directions; they often burn continuously for several days, temporarily reducing the country to a blackened waste which extends up to the very edge of the forest, where shrivelled leaves and charred trunks bear testimony against the maintenance of a permanent forest-boundary. And, although the effect of a single fire is undoubtedly small, it is very evident that the cumulative effect of such fires during a succession of years must be to materially extend the boundaries of the patanas at the expense of the forest.

That similar fires in other parts of the world cause the replacement of forest-vegetation by a herbaceous and low shrubby formation is so well-known that it need not be insisted upon here. Grisebach (15) has described it in India, Junghuhn (16) in Java and Sumatra, Johnston (**17**) in Central Africa, Bryce (**18**) in S. Africa, Humboldt (**19**) and Belt (**20**) on the Savannahs of S. America and Nicaragua, and Warming (**21**) on the Brazilian Campos.

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* I am indebted to my friend Mr. H. Stanley Jevons, F.G.S., for kindly examining the geological specimens referred to.

The experience of the Ceylon foresters, stated in the Annual Reports of Forest-conservancy, confirms the opinion that the constant occurrence of the patana-fires is gradually extending the area of the patanas in a westerly direction into that previously covered by forest. With regard, however, to the origin of the patanas as a whole, the case is not so clear; there is a total absence of local tradition relating to a time when the main area of the Uva patanas was in any marked way different from what it is now, and direct evidence of any kind relating to past changes is not forthcoming. There is, however, very strong reason for believing that the combined effects of the peculiar climatic conditions of the region and the recurrence of grass-fires have caused the disappearance of a savannah-forest from the area lying between 2000 feet and 4500 feet which is now covered by patana-vegetation.

Before considering this question in further detail, a brief general account of the climate of Uva must be given.

## *Climate.*

The distribution of rainfall over the central plateau of the Island is determined by the central range of hills, which, as has been pointed out above, runs in a general N.N.W. direction from Kirigalpotta through the plateau for about 40 miles. The prevailing winds during the two monsoons thus cross the ridge transversely.

The S.W. monsoon commences early in April, and the wind increases in force and constancy until the middle of May, when the heavier rains of the monsoon commence, and continue until the middle of August; the S.W. wind ceases about the end of September. During this monsoon, the south-western and most fertile part of the Island receives more than one-third of its total rainfall. The S.W. wind, having deposited the greater portion of its available moisture on the western slopes and summits of the central ridge, passes over the lower country to the east as a hot, dry, and often violent wind, still however carrying sufficient moisture to render fertile the summits of Namunukuli and other eastern hills which are sufficiently high to cool it below its saturation-point. Upon these hills is found a forest-vegetation of the same type as that which characterizes that zone of the western hills which lies between 4000 feet and 6000 feet; and these developments of the western forest are isolated in a country which is almost uniformly covered with patana or park vegetation. The climatic conditions of Uva, during the S.W. monsoon, are thus Continental rather than Insular, and compare remarkably with those of the much larger area of the Brazilian Campos. Here the Trade-winds, striking against the coast-ranges of S. Brazil, lose so much of their moisture that they pass over the lower country to the west as dry, hot winds, depositing no more moisture until they strike against the slopes of the Andes, which bear a forest of the same type as is found upon the coast-ranges in the east. The comparatively low intermediate country is covered with savannah-vegetation (22).

The rain-value of the S.W. monsoon decreases in an easterly direction from the central ridge, as is shown in the following table compiled from the returns of the Ceylon Meteorological Office and the Public Works Department. The table gives the amount of rain in inches and the number of rainy days, respectively, during the periods of the S.W. and N.E. monsoons.

| Station. | Elevation. | Situation. | S.W. Monsoon. | | N.E. Monsoon. | | Average of |
|---|---|---|---|---|---|---|---|
| | | | Rain-fall. | Rainy days. | Rain-fall. | Rainy days. | |
| Nuwara Eliya... | 6240ft. | 1 mile W. of Central ridge. | 60·9 | 117 | 39·28 | 85 | $26\frac{7}{12}$ years. |
| Hakgala ......... | 5581ft. | 4 miles E. of Central ridge. | 38·5 | 102 | 52·05 | 100 | 13½ „ |
| Bandarawela ... | 380ft . | 18 miles S.E. of Hakgala. | 24·8 | 51 | 40·81 | 76 | 25 „ |
| Badulla ......... | 2225ft. | 15 miles N.E. of Bandarawela.<br>18 miles E. of Hakgala. | 25·09 | 30 | 57·46 | 71 | 21 „ |

Of these stations, Bandarawela has the smallest rainfall, and Badulla the fewest rainy days during the S.W. monsoon. But in neither case can the rainfall be taken as typical of that of the Uva patanas; for Bandarawela is less than 5 miles from the southern boundary of the plateau, and the Badulla rainfall is influenced by the proximity of Namunukuli. Unfortunately, however, no data exist for any station more centrally situated, and whose climate is therefore typical for the greater part of the Uva patana region; but, from the appearance of the country and the experience of those who know it, we shall be justified in concluding that the precipitation at such a station as Attampitiya or Wilson's Bungalow, during the S.W. monsoon, is less than at Bandarawela or Badulla.

With this qualification, let us consider the Badulla statistics. From these it appears that 25·09 inches of rain fall in 30 days during the S.W. monsoon, *i. e.*, from the beginning of April to the end of September. February and March are dry months all over the Island; and we may therefore consider that at Badulla there are only 30 rainy days in eight months, viz. from the beginning of February to the end of September, and in these 30 days the rainfall is 25 inches. This rainfall, which is heavy while it lasts, falls upon an undulating country whose surface-drainage is good, and upon a surface naturally hard and penetrable only with difficulty; and the 30 rainy days are irregularly distributed over 6 months, during which the country is parched up under a tropical sun and a usually unclouded sky. The Uva patana-district is therefore a region which has a prolonged, though not severe, dry season during the prevalence of the S.W. monsoon.

The North-east monsoon, from which the greater part of the Island, including the eastern slopes of the mountains, receives the larger proportion of its rainfall, sets in a few days after the S.W. wind has ceased, usually about the middle of October. The period of this monsoon is a short one, as it ceases about the middle of January; the interval between this and the commencement of the S.W. monsoon—the latter half of January, February, and March—is a dry period during which hardly any rain falls in any part of the Island.

The rains during this monsoon are very violent in the Uva district, and as the water drains away it carries with it all the finer loose surface-débris, except such as is retained by the roots of the grasses and other soil-binding plants, which on the drier patanas is very little. This is particularly noticeable at Bandarawela, where the sides of the hills are bare of soil and support only a few deep-rooted plants on their stony surface: on the tops of the hills, where the surface is flat or slightly hollow, accumulation of soil does occur to some slight extent. The surface-drainage of the Uva patanas during the torrents of rain which fall at the beginning of the N.E. monsoon is a very remarkable sight: the streams which run off the slopes being loaded with fine débris * which makes no small contribution to the sandy character of the Mahaweli-ganga.

This monsoon, which constitutes the rainy season of the eastern slopes of the plateau, coincides with the period of the vegetative activity of the Uva patanas.

We have, then, in the Uva patanas a district, the greater part of which suffers a dry season of eight months' duration, modified only by about one month's rain which falls during the latter six of those months. During this period a constant and drying S.W. wind blows over the area and, the sky being usually unclouded, the surface of the ground is subjected to a severe baking by the rays of a tropical sun †. The rain which falls during the S.W. monsoon is distributed over a few days, and falls so rapidly that but little of it is absorbed by the ground; and this is even more strikingly the case with the very heavy rains of the N.E. monsoon, which remove such fine loose matter as is formed and render the accumulation of soil and humus impossible.

On the more elevated patanas to the west, the conditions are

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* Vincent, Report on Conservation of Ceylon Forests; Colombo, 1883, p. 72, § 114. Vincent here makes a statement with which it is impossible to reconcile the above account of erosion on the Uva slopes, which is, however, the result of personal observation. *Cf.* also Tennent, 'Ceylon,' p. 25.

† In some rough determinations of soil-temperature obtained by placing the bulb of a thermometer at a depth of 4 inches in the soil, the following results were obtained:—

| | | | |
|---|---|---|---|
| Wilson's Bungalow ... | 85° F. | Oct. 18, 1897, | at 12.15 P.M. |
| Bandarawela ........... | 79° F. | „ 30, „ | maximum. |
| Haputale.................. | 80°·5 F. | Nov. 2, „ | „ |
| Passara .................. | 80° F. | Aug. 14, „ | at 3.45 P.M. |
| Madulsima Ridge ...... | 90° F. | „ 15, „ | at 11.30 A.M. |

very different. As will be seen later, the rainfall above 5000 feet is comparatively large and uniformly distributed throughout the year. The air is always highly charged with moisture, and above 5000 feet dense fogs are very frequent and lasting*. Occasionally, at 6000 feet and upwards, the temperature sinks below 0° C., and a little hoar-frost is formed on the grass before sunrise.

Under these conditions, soil and humus accumulate to considerable depths at the tops of the hills and in the valleys, and to a less extent upon the slopes. In hollows from which the drainage does not readily escape, swamps are produced in which a considerable formation of humus, formed chiefly of the parts of species of *Sphagnum*, *Eriocaulon*, Cyperaceæ, and Gramineæ, may accumulate.

The term "patana," then, includes two very different formations, which can be almost separated by the 4500-feet line. Below this elevation we have a dry area, whose climatic conditions are comparable to those of an American savannah; above 4500 feet the climate and the soil alike have considerable resemblances to those of a European moor which in favourable localities becomes marshy.

### *Origin of the Patanas.*

The arguments in favour of attributing the origin of the patanas to the combined effects of the climate and the periodic grass-fires must now be considered.

If we imagine the patana-fires, and other causes which may be active in extending the patanas westwards to cease, and a consequent re-afforestation of the western patanas to commence—and experience shows that it does commence under such circumstances—the new forest-growth would reach in time an eastern limit, below and beyond which it would not extend. As the forest advanced it would increase the precipitation of

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[*] During three days (Aug. 9, 10, & 11) spent on Horton Plains (7000 feet), the atmosphere was not clear for half an hour, and for the greater part of the time we were enveloped in a dense mist. This is a common experience of visitors to Horton Plains.

Nuwara Eliya (6200 feet), so well known as a Sanatorium, is as constantly saturated with dense fogs as with its notoriously heavy rains. A well-known writer speaks of "the endless procession of grey clouds out of doors, as they come rolling down from the gloomy black forests on the dingy dank moor (*i.e.* patana), and the shuddering surface of the icy lake" (Haeckel, 'A Visit to Ceylon,' trans. by Clara Bell, London, 1883, p. 289).

rain, and would thus be enabled to descend the eastern slopes; but it would undoubtedly at length reach a limit beyond which the rainy portion of the period of the S.W. monsoon would be too short for the maintenance of a forest of the western type.

On the eastern boundary of the patana-region, at elevations not exceeding 4000 feet, there is a savannah-forest of which a description has already been given (*vide* p. 306). This forest flourishes in a climate which is almost identical with that enjoyed by the drier parts of the Uva patana-district. The peculiar feature of this savannah-forest, as has been pointed out, is that there is a total absence of shrubby undergrowth, and in place of it a growth of coarse grasses. We have only to imagine a sufficient depth of soil on the patanas, and it is then easy to see that such a forest might have flourished all over the now barren grassy plains of Uva. This is supported by the fact that in some of the driest parts of the Uva patanas, where the conditions have been such as to allow of the accumulation of soil, a considerable growth of small trees, such as *Dodonæa viscosa*, *Eugenia* sp., *Mussænda frondosa*, *Osyris arborea*, *Flacourtia* sp., *Psidium Guajava*, is found. This is strikingly the case in protected hollows in various localities, and also in open places at Bandarawela, Wilson's Bungalow, and elsewhere, where abandoned termite-heaps provide accumulations of soil to which is confined almost all the shrubby vegetation. It seems that the termite-earths resisted the N.E. monsoon rains long enough to allow of the establishment of such vegetation upon them as now protects them from being washed away by the rains.

It seems, then, a justifiable conclusion that the absence of soil on the greater part of the Uva patana-area below 4500 feet is of itself a sufficient reason for the absence of trees and tall shrubs; and, given a sufficient depth of soil, there can be little doubt that the whole of the Uva slopes below 4500 feet would bear a savannah-forest identical with that which now flourishes in the Park-country to the east. If this be granted, it is not difficult to account for the disappearance of the forest and the soil which supported it, assuming only that the modern system of periodically firing the grasses has been practised for centuries by the Singhalese graziers—an assumption which is undoubtedly a safe one, although, owing to the peculiar conditions of the case, it can be supported by no direct evidence.

What would be the effect of constantly recurring fires in such a forest as this? The grasses would be consumed by each successive fire, their young fresh growths appearing again during each rainy season. In this way the soil would be laid bare, and in this condition would receive the heavy rains of the N.E. monsoon, from the full force of which the crowns of the scattered trees would be no adequate protection. Thus, annually, the soil would become poorer by the carrying away in solution of its more soluble constituents, and shallower * by the mechanical erosion to which it would be subjected. Meanwhile the trees would suffer from the effects of successive fires, and all but the more resistant and hard-wooded species would, in time, become exterminated. As the vegetation became more sparse the action of rain on the soil would be greater, and as the soil decreased in depth and deteriorated in quality, only the more wiry and coarser grasses, and comparatively few of the hardier trees, would survive. Under these conditions, and with a sufficient lapse of time, it is easy to see how an area covered with a savannah-forest could be transformed to something identical with the patanas of to-day.

Abbay † states that it is impossible that the Uva patanas can have resulted from the action of recurrent fires on the forest, and he supports his view by three considerations, viz.:—

(1) That in other cases in Ceylon where forest has been destroyed by fire, it has been replaced by "Chena," *i. e.* low bushy scrub, and not by a grassy formation such as occurs on the patanas.

(2) That these grass-lands of Uva are poor and unproductive, and therefore the last pieces of ground which one would expect a native in search of pasture to select.

(3) That, if the patanas had really resulted from artificial causes, as is here maintained, there would be some traditional record of such a striking change having come over the face of the country.

It is undoubtedly true that the firing of the low-country forest, which, as has been pointed out, has a shrubby undergrowth, is followed by the appearance of "Chena" composed of the hardier and more-resisting forest undershrubs, or of an exotic *Lantana.* But this objection does not apply to the Uva patana-lands, for, reasoning from the present distribution of savannah-forest and wet-forest, one must conclude that the only forest which, under the present climatic conditions, can have existed on the Uva slopes below 4000–5000 feet must have been of the savannah-type which now covers the Park-country; and it is obvious that "Chena" cannot result from the firing of a savannah-forest, owing to the absence of a shrubby undergrowth. Above 5000 feet, as will be seen later, the patana has undoubtedly resulted from the disappearance of a montane wet-forest of the ordinary type; but here other causes, which will be referred to below, prevent the formation of a low scrub on the cleared ground.

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* A similar case of soil-denudation, owing to the action of heavy rains on a surface deprived of its natural covering by fire, has occurred on the slopes of the Siwalik Hills in N. India: *v.* Hess, "Der Forstschutz," transl. by Fisher in Schlich's 'Manual of Forestry,' London, 1895, vol. iv. p. 541.

† *Loc. cit.* p. 399.

With regard to the poverty of the Uva patana-lands, it has been pointed out that, according to the theory advanced, the poverty of the soil in both quality and amount is indirectly a consequence of the recurrent grass-fires; and further, instead of the Uva patana-lands being the last pieces of ground to be selected for clearing by a grazier, they would be far more likely to be chosen than any of the more luxuriant wet-forest, whose undergrowth would not supply the desired pasture.

Abbay's third objection is not one upon which much stress need be laid. An important argument can hardly be based upon the mere absence of tradition with regard to a change which must have occupied a very long period, possibly centuries, among a primitive pastoral people such as the Hill-tribes of Ceylon.

The opinion that the Uva patanas were once covered by a savannah-forest similar to that which now exists in the Park-country has been expressed more than once in the reports of the forest-conservators (**23**); and it has been continually pointed out in the same reports that the present custom of firing the patanas, which, as has been seen, is probably a survival of that which produced them, is causing the further deterioration of the soil (**24**) where any still remains, and the destruction of all but the coarser and more enduring species of grass (**25**). And, therefore, according to the short-sighted policy of the grazier, the annual patana-fires become more necessary each year.

On the eastern slopes of the main ridge up which, as has been seen, the patanas extend to the highest elevations, very different conditions have resulted in the formation of a type of patana differing considerably from those of the lower plains of Uva, and upon which a considerable accumulation of humus has taken place. The patana and forest here exist side by side under conditions which, as far as can be ascertained, are absolutely identical; and the only conceivable explanation of the existence of patanas above 5000 feet is that they have arisen upon ground which has been cleared of forest by grass-fires. And that this is the true explanation there can be little doubt, when the effect of recent fires upon the edge of the forest is observed.

The rainfall above 5000 feet is not only much larger than in Uva, but is also evenly distributed over the year, so that there is no dry season to act upon the areas which have been bared of forest. At Hakgala, which probably has a smaller rainfall than any other patana-district above 5000 feet, the annual fall is about 90 inches, and there are annually 202 rainy days which are evenly distributed over the year, as is shown in the two upper lines of the following table, which give the averages of:—

1. The monthly rainfall;
2. The number of rainy days in the month, computed from the records of the Hakgala Meteorological Station for 15 years (1882–1896).

| | Jan. | Feb. | Mar. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall ......... | 8·12 | 2·97 | 4·67 | 7·18 | 7·71 | 7·33 | 5·88 | 4·48 | 5·75 | 10·55 | 10·67 | 14·98 | 90·78 |
| Rainy days ...... | 16 | 9 | 10 | 16 | 16 | 20 | 19 | 18 | 18 | 23 | 20 | 22 | 207 |
| Mean Air temp. in degrees Fahr. | 59·7 | 63·3 | 63·6 | 64·5 | 66·2 | 62·6 | 63 | 62·1 | 63·8 | 61·2 | 61·5 | 5·99 | |
| Mean daily range in degrees Fahr. | 13·9 | 12·2 | 18·1 | 15·5 | 14·7 | 10 | 11·7 | 11·3 | 14 | 9·7 | 10·4 | 8·8 | |

The humidity of the air is thus considerable and aconstant.

The last two lines of the table give the monthly summaries of the daily temperature-observations made at Hakgala * during 1897 (January to July) and 1896 (August to December). From these it will be seen that the air-temperature at Hakgala is hardly more than that of an English summer.

These conditions, viz., the extreme humidity of the air and the moderate and uniform temperature, are favourable to the accumulation of humus upon a soil which does not possess a high degree of porosity (**26**). It is, however, a well-known fact that humus does not accumulate in Indian and Ceylon forests except at high elevations; and in the forests of Ceylon, even at the highest elevations, the decomposition of plant-remains proceeds so rapidly that no considerable formation of humus can take place †. The experience of foresters, however, shows that the removal of forest-growth, when the temperature is not too high, the rainfall not too low, nor the soil too porous, is favourable to the formation of humus-deposits, and, if the land has a suitable contour, to the production of swamps. The disappearance of the trees has a twofold effect in producing an increase in the humidity of the soil. It has been estimated that one-quarter of the amount of the rainfall never reaches the ground in a forest, owing to so much of the falling water being broken into spray as it falls upon the foliage and reabsorbed by the air (**27**); and, in addition to this, cleared ground loses much less water by evaporation than when its moisture is drawn upon by the roots of transpiring forest-trees (**28**), and this is especially true of a district where the air is always charged with moisture and where consequently the evaporation from the surface of the ground is slow. And further, the exposure to light occasioned by the removal of the forest-covering is in itself a cause of decrease in the rate of bacterial decomposition of organic remains (**29**).

These factors have undoubtedly co-operated in the formation of the patanas above 5000 feet which are universally covered with humus-deposits except on some wind-swept patches at high elevations, and where they are interrupted by variously-sized boulders of unaltered gneiss which crop out irregularly. The deposits vary in thickness from a few inches to 5 feet or more*. They are thickest on the tops of the hills and in the valleys, where, under suitable conditions, so much water is retained that a swamp is formed. On the slopes, in spite of the rainwash, humus accumulates, though in less quantity than in more favourable situations; on the steeper hill-sides, channels sometimes as much as a foot in depth are cut into the humus by the water as it flows off the surface. The soil is an almost pure humus, black or coloured dark brown by the admixture of mineral substances; but apparently pebbles are always absent. It varies in consistency from a black mud to a powdery soil such as the wind will remove as dust, though this last condition is rarely seen, as it normally contains considerable quantities of water. The absence of earthworms is also remarkable, and is probably not without effect in contributing to the formation of a pure humus-soil **(30)**. The reactions of the soil were not observed; attempts have, however, been made to use it for gardening purposes at the Hakgala Botanic Gardens, and it has been found to be too "sour" to be of any use. Mosses play no part in the formation of these deposits, except in the swampy hollows, where species of *Polytrichum* and *Sphagnum* are found †. Elsewhere they are principally formed from the remains of grasses and Cyperaceæ, which both individually and specifically constitute the greater proportion of the flora. In the more swampy localities Eriocaulons are abundant. The only tree found upon these "humus-patanas" is the Rhododendron, which is well known to flourish on sour humus **(31)**.

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* I desire to acknowledge the courtesy of Mr. W. Nock, the Superintendent of the Hakgala Meteorological Station, in supplying me with these and other statistics.

† At Hakgala (5600 feet) it is impossible to obtain leaf-mould from the neighbouring forest for the Botanic Gardens.

The humus disappears quite suddenly where the patana passes into forest. There is usually a tendency for such formations as this, especially when they have a swampy character, to encroach upon the surrounding forest **(32)**. This may be the case in certain localities where the humus-patanas are wet and swampy, but there is no evidence of such encroachment, and indeed the prevailing opinion among those who are best able to judge is that, where not interfered with by fire, the forests tend to reinstate themselves. This process is, however, even under the most favourable circumstances, very slow, being hindered by several of the well-known properties of humus.

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* A recent cutting made during the construction of a new road near Ambawela (5900 feet) passes through a small swamp and exposes 10 feet of wet black humus composed of the parts of *Eriocaulon Wightianum*, together with *Anaphalis oblonga*, *Exacum zeylanicum*, *Polygala glaucoides*, *Blumea flexuosa*, &c.

† "True peat" is stated to be formed in the hollows on the Nilghiris, by "the growth and decomposition of a moss." Medlicott and Blanford, 'Manual of the Geology of India,' Calcutta, 1879, p. 429.

Humus has a greater capacity for water-absorption than any other soil (**33**), a fact which militates against the spread of forest-trees. By it the normal distribution of water in the soil is disturbed, the upper layers becoming wet at the expense of the lower. As a consequence the germination of the seeds of forest-trees is hindered by the excess of water near the surface (**32**), and at the same time, at a greater depth, the soil is rendered too dry for the nourishment of deep-rooting trees. The normal respiration of the roots also is impaired by the presence of hydrostatic water, and consequent poverty of the soil in free oxygen (**32**). A further consequence of the excess of water in the humus is that the soil-temperature is below that which is normal for the latitude and elevation—a fact which must have a considerable effect upon the germination of seeds (**32**). There are no observations to show what are normal soil-temperatures for given soils in such a locality as this; but it may be interesting to compare the following rough determinations made upon the humus-patanas at a depth of 4 inches, with those made on the dry Uva patanas at lower elevations (*v.* p. 313):—

| | |
|---|---|
| Hakgala (5600 ft.). | 66° F., Aug. 19, 9.30 A.M. |
| „ „ | 67° F., Oct. 14, 12.30 P.M. |
| „ „ | 66° F., Nov. 3, maximum. |
| „ „ | 61° F., Oct. 26–27, minimum. |
| Sita Eliya (5800 ft.). | 63°·5 F., Oct. 20, 9 A.M. |
| Horton Plains (7000 ft.). | 59°·2 F., Aug. 10, noon. |

Of considerable importance in hindering the advance of forest-growth over the humus-patanas are the acid properties of the soil. The humus-acids produced in the superficial layers sink to lower depths and render the lower soil acid—a condition which is known to be very disadvantageous to the growth of most European woody species (**31**), but favourable to the Rhododendron and a few others. We have further, in the acidity of the humus, and the abundance of ferrous oxide which is the predominant colouring-material of the soil underlying it, conditions which are in every way favourable for the formation of a moor-pan, the effect of which in preventing the penetration of the roots of trees is too well known to need description; there is, however, at present no direct evidence of the existence of such a formation beneath the humus-patanas.

Lastly, it may be pointed out that bacteria do not flourish in acid humus (**33**), and that the consequent poverty of such a soil in combined nitrogen would co-operate with other factors against the establishment of a luxuriant vegetation.

### *Summary.*

An examination of such evidence as exists with regard to the origin of the patanas of Uva and their western extensions up the slopes of the central ridge leads to the following conclusions. On the Uva slopes below 4500 feet (the lower limit of the Rhododendron) the peculiarities of the climate have co-operated with the periodically recurrent grass-fires to transform an open forest of low xerophytic trees with an undergrowth of grass (*i. e.* a Savannah-forest such as is still found on the eastern boundary of the plateau) into barren grassy plains. These plains being almost completely denuded of soil must be regarded as being of the nature of a permanent savannah, the natural re-afforestation of the greater part of which is impossible under the present climatic conditions. Above 4500 feet, wide tongues of patana extend in a westerly direction up to, and in some cases over, the summit of the central ridge. There can be no doubt that these extensions are due to the encroachment of the Uva grass-fires into the montane wet-zone forest. Upon the cleared area a herbaceous vegetation has established itself, the remains of which form an accumulation of sour humus which is almost uniformly present on the surface above 4500 feet. The properties of sour humus are such that forest-trees can with difficulty re-establish themselves upon it. It therefore follows that, apart from the effects of the present annual fires, the sharp boundary, once established by fire, would so gradually become irregular by the advance of forest-growth that only careful observations extended over a long period would be able to detect any change. Hence has arisen the idea that the present limit of the forest is a stationary one.

### *General Biological Features of the Flora.*

The flora of the patanas as a whole is composed of plants which, generally speaking, present characters which tend to reduce transpiration and to protect delicate parts from the injurious effects of intense illumination: broadly speaking it may thus be regarded as a "Xerophyte-Association" in Warming's sense (**35**). In the case of the Uva patanas below 4500 feet, the conditions which determine the characteristic features of the flora are, briefly, intense illumination, the heating effects of the rays of a vertical sun, and a comparatively dry season of eight months' duration, during six months of which a drying wind blows constantly over the area and the sky is usually unclouded. The evaporation from the surface is therefore intense—a fact which must have a considerable influence upon the vegetation of a district which has little standing water, and but little soil by which absorbed water may be retained, and which therefore depends for its water-supply upon dew and rainfall; and the latter, as we have already seen, is, during the dry season, comparatively small in amount; and what little there is, by reason of the undulation of the country and the hardness of the surface, tends to run off rather than be absorbed. Therefore the supply of water to the roots is small, and the necessity for the reduction of transpiration imperative.

Above 4500 feet the climatic conditions are widely different, as has already been pointed out. The rainfall is large and almost evenly distributed over the year and is accompanied, especially at higher elevations, by dense fogs and heavy clouds which obscure the sun's rays usually for a considerable portion of each day *. The rate of evaporation from the surface and the periods of intense illumination must therefore be considerably less than on the Uva patanas; and further, the soil always retains considerable quantities of water. Nevertheless, plants with marked xerophytic characters predominate here as at lower elevations, a fact which is at first sight somewhat surprising. These humus-patanas at 5000 feet and upwards, existing under a warm temperate climate, may be compared with the moor- and marsh-formations which are particularly characteristic of temperate climates. It is well known that the plants constituting such formations commonly present marked xerophytic characters, and to explain these several theories have been advanced (**35**). Of the factors which have been important in the selection of xerophytes or in the adoption of xerophytic characters on the humus-patanas, the following are probable:—

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* See pp. 314 and 332.

(1) The bad ventilation and comparative low temperature (**36**) of the soil, due to the presence of hydrostatic water, and the consequent lowering of the respiratory activity of the roots.

(2) The high power of capillary absorption possessed by a peaty soil (**33**), by reason of which the absorption of water by the roots is less than in any other soil containing an equal proportion of water.

(3) The presence of the humus acids of the soil, which still further impair the activity of the roots (**31**).

These three factors combine in lowering the functional activities of the roots; and since the functions of the aerial parts must be in correspondence with those of the roots, the acquisition of xerophytic characters has been necessary.

The flora of the dry patanas, *i. e.*, speaking generally of the patanas below 4500 feet, compares in many respects with that of the South American savannahs (**37**).

There is, for example, an absence of plants with bulbs or tubers, and in the following list of patana-plants true succulents are rare. This is probably due to the fact that the dry season, though long, is not excessively severe, and the wet season, in which the Uva vegetation wakes up to renewed activity, is not extremely short; and therefore such an effectual protection against evaporation and such a large storage of water as a bulb or tuber affords to enable the plant to endure excessive drought, and afterwards to pass rapidly through its vegetative and reproductive periods during a very short wet season, are unnecessary. Another point of correspondence between the savannahs and the patanas is seen in the large proportion of perennials as compared with the annual species: this is true for the dry patanas, and equally so for those situated above 4500 feet. The perennials constitute 86 $^{\circ}/_{\circ}$ of the flora above 4500 feet, and below 4500 feet 87·3 $^{\circ}/_{\circ}$. In general, a dry climate is favourable to the development of annual species (**38**), since the seed or the fruit is obviously the best form in which a plant can tide over a dry season. On the patanas, however, as on the savannahs, the periodic fires, which destroy the aerial parts of all the less-resistant species, are a controlling factor in the selection of perennials possessing subterranean parts which resist the action of fire and from which the aerial parts are reproduced in the following season.

The "rootstock" has various forms—*e. g.*, a rhizome, which is frequently very deep in the ground (*Pteris*); a small herbaceous structure (*Lagenophora*, etc.); an erect and fleshy body (*Curculigo*, in which it is sometimes as much as 12 inches long); a tuber (*Drosera peltata*); or a gnarled woody, more or less branched body (*Knoxia*, and the majority of the shrubby species). The root-system is, as a rule, highly developed, *i. e.*, much branched and widely spreading. Tuberous fleshy roots are common (*Curculigo*, *Lagenophora*, *Heracleum*, etc.). Six species of ground orchids, with root-tubers, are also present, and associated with them is a Mycorhiza, at least in some cases. The grasses are tufted in habit, except at high elevations, and low in growth; their leaves are narrow, rough, stiff, and usually erect. Lichens, mosses, and algæ are quite absent from the dry patanas, and rare even at higher elevations; both *Sphagnum* and *Polytrichum* are found in swampy places; *Usnea* grows luxuriantly upon the Rhododendron above 6000 feet; and a *Collema* is sometimes present on the damp surface of the ground among the grasses. Where the grasses grow in thick tufts with damp shady ground between them, there flourishes a flora of low, delicate shade-plants; these include species of *Viola*, *Potentilla*, *Serpicula*, *Hydrocotyle*, etc.

The evaporating and illuminating effects of the sun's rays are very effective all over the patanas, particularly below 4500 feet; over which, as we have seen, the sun is much less obscured by cloud than at higher elevations. In relation with this we find that characters which tend to effect the regulation of transpiration, and a lessening of the degree of illumination of the leaves and other easily injured parts, are commonly developed. Among the more obvious of these are:—

The rolling of the leaf; which is, however, never very pronounced, for, as on the savannahs, the "ericoid" and "pinoid" types of rolled leaves are entirely wanting (**39**).

Plants with very small, usually linear leaves are common.

Leaves are frequently numerous and crowded together—a condition in which the majority are shaded at the expense of the rest.

In many species the leaves are mostly radical or rosulate; those on the upper and more exposed parts of the erect stem being few, small, and usually erect.

A red or purple pigment is very commonly present in the leaves—particularly the young leaves—and young shoots of patana-plants. Diverse and conflicting views as to its functions have been advanced (**41**); here it is possibly important as a screen against too intense illumination (**40**). The pigment is usually contained in the cells of the glabrous leaf; less commonly a more or less dense covering of yellow or brown hairs (*Crotalaria* sp.) provides a light-screen as well as a means of reducing transpiration.

All stages of hairiness are commonly found on the leaves of patana-plants—the most pronounced cases being the densely lanate or floccose leaves of species of *Anaphalis*; in all these cases the hairs are more abundantly developed on the younger parts. In *Knoxia platycarpa*, a small shrub whose adult leaves are erect or semi-erect and perfectly glabrous, the young leaves bear fugitive hairs. In many cases, particularly in those occurring below 4500 feet, the hairs doubtless function as a means of reducing transpiration; above 4500 feet, particularly at the higher elevations where the most pronounced hairiness occurs, its use to the plant must be rather as a protection against cold, and perhaps more especially as a means of preventing the wetting and consequent blocking of the stomata—a function which must be of considerable importance in an atmosphere so constantly saturated as is that of the more elevated portions of the region with which we are concerned.

A hanging position is so common as to be almost normal for the young leaves of shrubby species occurring on the lower patanas. The delicate tissues thus escape the injurious effects of directly incident illuminating and heating rays (**42**).

The presence of an ethereal oil in the leaf is a common occurrence in the Labiatæ of the patanas, and more particularly in the well-known "Citronella" or "Mana" grass (*Andropogon Nardus*). This grass is found abundantly from 5000 feet downwards, and frequently forms a belt at the edge of the patana parallel with the forest-boundary; it attains a height of five feet or more. In strong sunlight it emits a sickening and almost overpowering odour of Citronella oil. The secretion of ethereal oils is a very common character of dry-climate plants (**43**). The explanation usually given of the function of such an oil is founded upon Tyndall's observation that radiant heat is arrested by minute quantities of the vapour diffused through the atmosphere, and is to the effect that the evaporation of the oil by the heating effect of the sun's rays causes the air surrounding the leaf to be charged with vapour, which acts as a screen protecting the leaf to some extent from radiant heat from without (**44**). It has, however, been pointed out by Dixon (**45**) that such a screen absorbs those heat-rays which it does not transmit, and that its temperature is thereby raised, and it thus encloses the leaf in a heated chamber; therefore the mere physical effect of an ethereal oil-vapour screen would be to raise, rather than lower, the temperature of the leaf. Dixon has further shown (**45**) that certain ethereal oil-vapours act biologically in decreasing the rate of transpiration when they are in contact with transpiring leaves; in the case of the essential oil of *Artemisia Absinthium*, he found that the vapour reduced the rate of transpiration by 13 °/₀ in the leaves of *Syringa vulgaris*, and by 7 °/₀ in those of *Cytisus vulgaris*. It may be that "Citronella" oil-vapour has a stronger effect upon the rate of transpiration of the leaves of Mana grass than is represented by these figures; otherwise it is difficult to believe that so small a reduction effected by an agent which itself raises the temperature of the leaf, and therefore presumably its rate of transpiration, can be of much service to the plant as a means of regulating the rate of transpiration. Mana grass has a marked gregarious habit, generally covering wide patches of ground below 5000 feet, where the slope or other quality of the surface has allowed an unusual accumulation of soil. In the heat of the day the Citronella perfume can be detected at some distance from its source, and it is conceivable that if it has an effect in reducing transpiration, of the nature indicated, the effect must be felt by the plants in the neighbourhood, as well as by the Mana grass itself.

A permanent erect profile position of the leaf is very common, and this applies not only to many patana-plants, but is also characteristic of very many of the trees which compose the montane forest above 5000 feet. In very many more cases, however, the leaf makes a small angle (*i. e.* less than 45°) on its upper side with the stem; incident light strikes a leaf in this position at a high angle, and therefore has a smaller illuminating and heating effect than on a horizontal leaf of the same area. In the following descriptions this position is denominated "semi-erect."

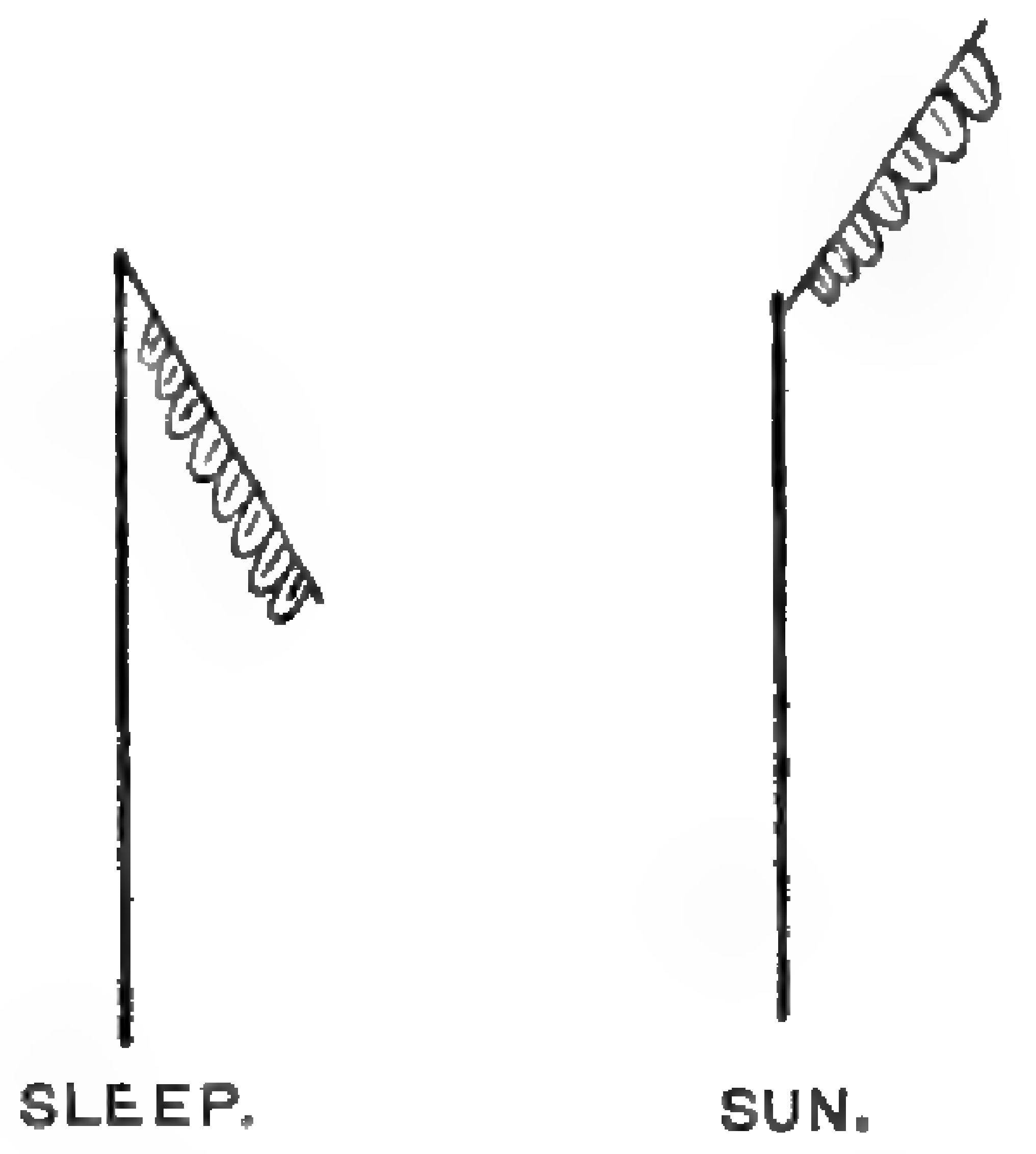
Many leaves whose vernation is conduplicate never completely unfold, and the two halves remain more or less inclined to one another. Such a leaf receives the light- and heat-rays at a high angle, as in the case of the semi-erect leaf.

In many cases the leaves or their parts move into a profile position and remain there while the sun is near the zenith. This movement is a direct effect of illumination (**46**), and is doubtless a means whereby the chlorophyll is protected from the effects of intense light (**47**), rather than a method of regulating transpiration, although the latter may be to some extent influenced. Usually, leaves which show sun-movements are also subject to sleep-movements, although in some cases one form of movement was observed and not the other, which, in some cases at least, was almost certainly due to lack of opportunity of observation. Movements were observed in species of the following Natural Orders:—Oxalidaceæ, Leguminosæ, Euphorbiaceæ, and Gramineæ. For convenience of a brief description of the types of movement which were noted, the following four divisions will be used:—

(1) Leaves whose sleep-position is the same as the sun-position; *i. e.*, the position assumed during the hours of most intense sunlight. This class includes three species, viz.:—*Oxalis corniculata*, *Crotalaria rubiginosa*, and *Phyllanthus simplex*. In *Oxalis corniculata* the sun- and sleep-position assumed by the leaflets is well known in the genus as a sleep-position (**48**). The monophyllous leaves of *Crotalaria rubiginosa* rise up vertically until the ventral surface of the leaflet is in contact with the stem. This has been described by Thiselton-Dyer as a sleep-movement (**49**). In *Phyllanthus simplex* the small closely placed leaves move upwards towards the stem and close tightly upon one another in an imbricate manner, at night and in bright sunlight, as has been described by Massart for *P. ovalifolius* (**50**).

(2) Leaves whose sleep-position differs from their sun-position.

*Biophytum proliferum.*—In the sleep-movement the rhachis of the pinnate leaf sinks until it makes an angle of about 30° with the stem, on its lower (dorsal) side. At the same time the leaflets fall independently, until they hang downwards in a vertical plane, the dorsal surfaces of opposite leaflets being in contact. In the sun-position, the leaflets are bent downwards as in sleep, but the rhachis, instead of sinking, rises until it occupies an approximately erect position (see diagram).



*Biophytum proliferum.*

*Smithia blanda.*—In moving into the sleep-position, the leaf sinks * upon its pulvinus and the leaflets move upwards and forwards until their ventral surfaces are in contact with the rhachis or with the dorsal surfaces of the more distal leaflets. In the sun-movement the leaf was not observed to fall, but the leaflets move into approximately the same position as they occupy in the sleep-position, though they are not so tightly closed as in the latter case.

*Cassia Kleinii* and *C. mimosoides.*—The leaf-movements in these plants are the same as in *Smithia blanda*, except that in *C. Kleinii*, in the sleep-position, the distal end of the rhachis is bent lower than the proximal end and the rhachis is bow-shaped, the concavity being on its dorsal side. These species form an exception to the rule in the genus, that the leaflets fall in attaining the sleep-position †.

*Phaseolus trinervius* and *Atylosia rugosa.*—The sleep-position of the leaflets of the trifoliate leaves of these plants is the same as that described by Darwin for *Phaseolus vulgaris* (**51**). A movement of the petiole was not observed. In *Atylosia rugosa* the younger leaves assume the sleep-position before the older ones. In the sun-position the leaflets stand erect upon the erect petiole, the ventral surfaces of the two lateral leaflets being in contact with the ventral surface of the terminal leaflet (see diagram).

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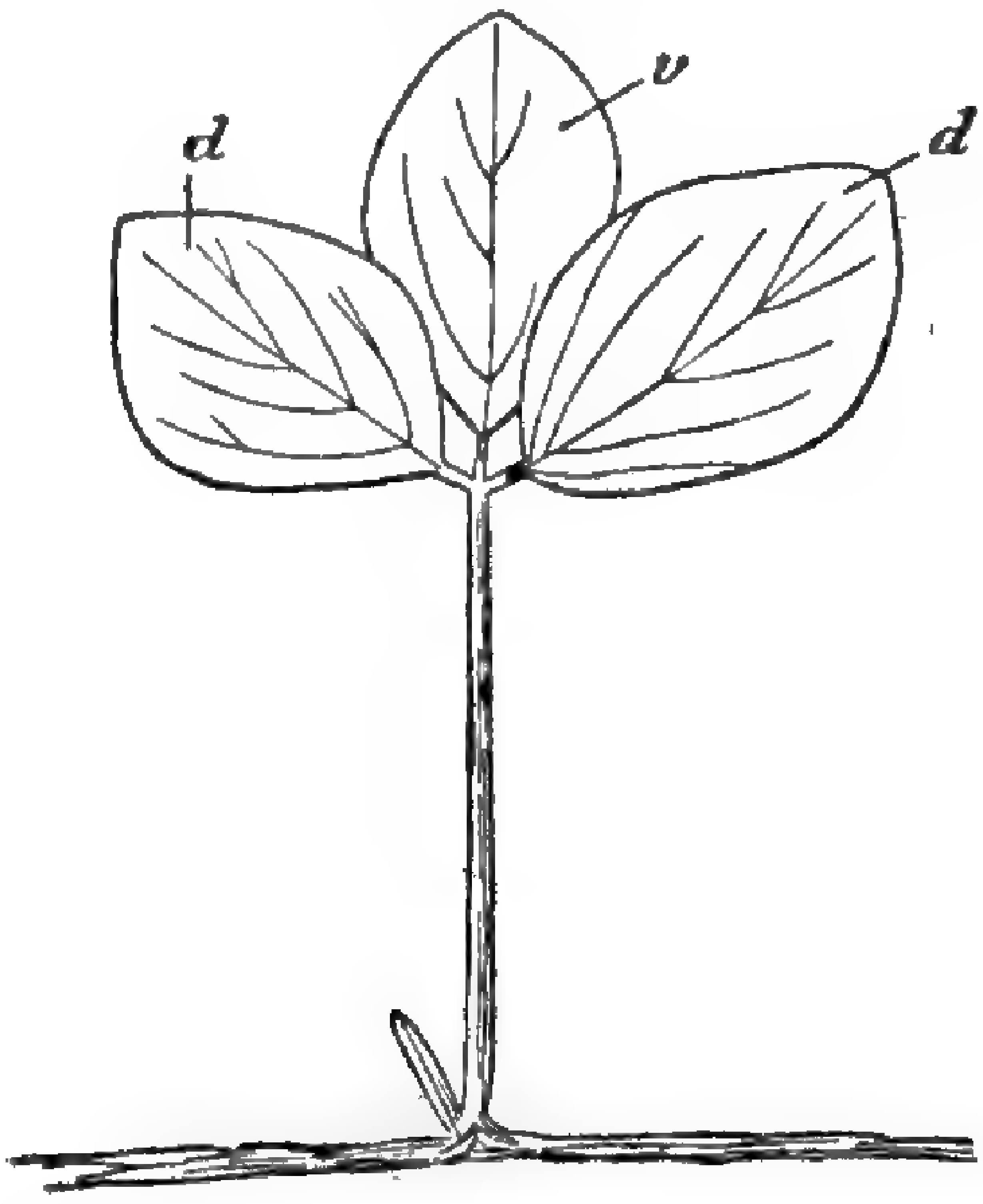
* *Cf.* the movement in *S. Pfundii.* Darwin, 'Movements of Plants,' p. 356.

† The sleep-movements of *C. mimosoides* are described by Darwin, *loc. cit.* p. 372.



*Atylosia rugosa.*
Diagram of a leaf in the sun-position. $d$=dorsal surface of leaflet; $v$=ventral surface of leaflet.

Thus, in passing from the sleep-position to the sun-position, each leaflet describes an angle of 180° upon its pulvinus. In *Atylosia rugosa* the terminal leaflet, in moving into the sun-position, becomes erect before the lateral leaflets have become vertical, and often before they have left the horizontal position.

(3) Leaves which move into a profile position during intense sunlight, but in which sleep-movements were not observed.

*Crotalaria semperflorens*, var. *Walkeri.*—This plant has long horizontal prostrate branches; the leaves are monophyllous and alternate. In strong sunlight the leaves rise up to an erect position and stand in two parallel planes, the dorsal surfaces of the leaves of each row being directed outwards.

*Zornia diphylla.*—The leaf consists of two small ovate-lanceolate leaflets and a moderately long petiole. In bright sunlight the leaflets move upwards and forwards until they are almost in the same straight line with the petiole, and include an angle of about 30° between their ventral surfaces.

*Desmodium parvifolium.*—The leaves are monophyllous and variable in size on the same plant, and on comparatively long petioles. In bright sunlight the leaflets move into a profile position, though the manner of doing this is not the same in all the leaves belonging to the same plant. The petiole appears to rise in all cases: the leaflet in some cases merely twists on its pulvinulus, so as to present an edge to the sky; in other cases the leaflet assumes a vertically hanging position; or, again, it may become erect on the top of the nearly erect petiole.

*Andropogon zeylanicus.*—This grass is very plentiful on the patanas at about 5000 feet. In bright sunlight the erect leaf closes on the midrib as a hinge, so that the ventral surfaces of the two halves come into contact.

(4) Leaves which show sleep-movements, but were not observed to move into a sun-position.

***Pycnospora hedysaroides*** and ***Atylosia Candollei*** show sleep-movements of the leaves, of the same nature as those so well known in ***Oxalis Acetosella***, etc. (**52**).

A plant deserving special notice by reason of its remarkable habit is *Hedyotis verticillaris* (Rubiaceæ), which occurs abundantly at 6000 feet and higher elevations. This species grows gregariously, and covers wide patches in wet places on the patanas; its aloe-like habit distinguishes it from all other members of its natural order. Its leaves are all radical and erect, or nearly so, forming a hollow rosette, in the concavity of which water to a considerable amount is retained by the close-fitting bases of the leaves. The stipules are lanceolate structures, from 1 to 2 inches in length, and bear numerous shortly-stalked glands on their margins; they are immersed in the water which the cup contains, a position which suggests that they may have an absorptive function. The fibrous remains of old leaves persist round the base of each plant and retain a considerable amount of water. A similar persistence of the remains of dead vegetative parts is found in several of the grasses—"Tunika-Gräser" (**53**)—Cyperaceæ, Eriocaulonaceæ, etc.

Shrubby plants growing in certain situations on the patanas are considerably affected by the S.W. wind, which is often very strong, and always more or less constant for six months in the year. This is particularly the case in the valley in which the Sita Eliya and Hakgala patanas are situated, which has an east and west trend, falling rapidly to the east. Here we find a much greater development of foliage and flower-buds on the east than on the west side of tall plants. This is very marked in the Rhododendron, the shrubs *Hypericum mysorense, Atylosia Candollei,* etc., and the Jungle-trees. It is probably due largely to the mechanical injuries inflicted by the wind on the buds on the west side of the tree; the chilling effect of the moisture-laden air also has a greater effect on the west than on the east side. The dwarfing effect of the wind is seen in a remarkable manner in ascending from the Hakgala Botanic Gardens (5600 ft.), to the top of the steep Hakgala rock (7000 ft.) behind them. At 5600 feet the trees are 30 feet or more in height, but gradually diminish in size as the higher and more exposed parts of the hill are reached; at the summit, the arborescent vegetation is composed of knee-high, crooked and gnarled specimens of species which attain the normal height a thousand feet lower down; and in these the majority of the buds develop on the east side. The prevailing direction of the illumination is probably another factor in producing this eastward development of shrubs and trees in the Hakgala valley. During both monsoons it is a common experience, on the eastern slopes of the main ridge, that the mornings are fine while the afternoons are cloudy or wet. This generalization is borne out by the following figures, which give the mean proportion of clouded sky * at 9.30 A.M. and 3.30 P.M. respectively for each month during 1897 at Hakgala (**55**).

| | Jan. | Feb. | Mar. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Whole Year. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9.30 A.M. | 5·2 | 3·8 | 3·6 | 4·4 | 4·6 | 7·2 | 6·0 | 7·2 | 66 | 4·8 | 6 2 | 7·5 | 5·5 |
| 3.30 P.M. | 5·7 | 5·8 | 7·3 | 8·1 | 7·7 | 7·8 | 7·2 | 9·1 | ·6 | 7·3 | 8·8 | 8·8 | 7·7 |

It follows from these figures that a markedly larger proportion of direct sunlight falls on the Hakgala and Sita Eliya patanas during the morning than in the afternoon, and therefore the eastern side of a tall plant receives more direct illumination than the western.

## *List of Plants.*

On pp. 334–362 is given a complete list of the plants collected on the patanas during the period indicated above. In a few cases a plant which was not collected is given as a patana-plant on the authority of Trimen.

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* 10 denoting a sky entirely and continuously overcast, and zero a cloudless sky.

The principal localities visited, from which plants included in this list were obtained, are the following:—Pedurutalagala (8296 ft.); Nuwara Eliya (6200 ft.); Sita Eliya (5800 ft.); Hakgala (5600 ft.); Horton Plains (7000 ft.); Wilson's Bungalow (4000 ft.); Bandarawela (3800 ft.); Haputale (4400 ft.); Badulla (2200 ft.); Passara (2500 ft.).

No plants hitherto unrecorded for Ceylon have been found on the patanas. In several cases, however, species have been found at elevations above or below the respective limits recorded by Trimen in the 'Handbook,' or by Hooker in the 'Flora of British India.' Of these the following are the most important:—

| | | | | |
|---|---|---|---|---|
| *Polygala rosmarinifolia*, Wight & Arn. | Found at | 3800; 5600 ft. | —Trimen: | Up to 4000 ft. |
| *P. telephioides*, Willd. | ,, | 3500; 3800 ft. | ,, | Low country only. |
| ,, ,, | | 4400 ft. | ,, | ,, ,, ,, |
| *Eurya acuminata*, DC. | ,, | 3800 ft. | ,, | Low country to 2000 ft |
| *Triumfetta rhomboidea*, Jacq. | ,, | 3800 ft. | ,, | Waste ground, low country. |
| *Crotalaria nana*, Burm. f. | ,, | 5800 ft. | ,, | Low country, rare. |
| *C. verrucosa*, Linn. | ,, | 5600 ft. | ,, | Low country to 2000 ft. |
| *Phaseolus adenanthus*, G. Mey. | ,, | 5800 ft. | ,, | Up to 4000 ft. |
| *P. trinervius*, Heyne. | ,, | 5600 ft. | ,, | 1000-4000 ft. |
| *P. calcaratus*, Roxb. | ,, | 5600 ft. | ,, | ,, |
| *Cassia Kleinii*, Wight & Arn. | ,, | 3800 ft. | ,, | Low country, moist and dry. |
| *C. mimosoides*, Linn. | ,, | 5800 ft. | ,, | To 4000 ft. |
| *Rhipsalis Cassytha*, Gaertn. | ,, | 5600 ft. | ,, | Up to 4000 ft. |
| *Vernonia Wightiana*, Arn. | ,, | 2500; 3800 ft. | ,, | Above 4000 ft. |
| *Blumea flexuosa*, C. B. Clarke. | ,, | 2500; 3800 ft. | ,, | Above 5000 ft. |
| *Anaphalis oblonga*, DC. | ,, | 2500 ft. | ,, | 4000 ft. and above. |
| *Jasminum angustifolium*, Vahl. | ,, | 4000 ft. | ,, | Up to 2000 ft. |
| *Evolvulus alsinoides*, Benth. | ,, | 3800; 4000 ft. | ,, | ,, |
| *Striga euphrasioides*, Benth. | ,, | 3800 ft. | ,, | Damp sandy soil in the dry region. |
| *Utricularia bifida*, Linn. | ,, | 3000 ft. | ,, | Low country. |
| *Didymocarpus Humboldtiana*, Gardn. | ,, | 5600 ft. | ,, | Up to 5000 ft. |
| *Pogostemon reflexus*, Benth. | ,, | 7000 ft. | ,, | Up to 6000 ft. |
| *Leucas marrubioides*, Desf. | ,, | 5600 ft. | ,, | Up to 5000 ft. |
| *Glochidion zeylanicum*, A. Juss. | ,, | 4000 ft. | ,, | Up to 2000 ft. |
| *Breynia patens*, Benth. | ,, | 4000 ft. | ,, | Up to 3000 ft. |
| *Burmannia disticha*, Linn. | ,, | 5800 ft. | ,, | Up to 2000 ft. |
| *Commelina nudiflora*, Linn. | ,, | 5800 ft. | ,, | Low country. |
| *Fimbristylis pentaptera*, Kunth. | ,, | 7200 ft. | — (Fl. B. Ind.) | Up to 6000 ft. |
| *Carex spicigera*, Nees, var. *minor*. | …… | Horton Plains. | — ( ,, ) | Pedurutalagala. |

*Pedicularis zeylanica*, Benth., *Exacum Walkeri*, Arn., and *E. zeylanicum*, Roxb., are stated by Trimen to be annuals. The first of these is a marked perennial, with a large persistent woody rootstock; both species of *Exacum* are certainly biennial, if not perennial.

In the following list the names of endemic species are printed in italics. A short description of the more apparent features of biological interest is appended to each species; a full systematic description will be found in the 'Flora of British India,' or in Trimen's 'Handbook to the Flora of Ceylon,' or, in the case of the vascular Cryptogams, in Baker's 'Synopsis Filicum' (1883), or 'Fern-Allies' (1887), to which references are given. The collection numbers, with the elevation from which each specimen was obtained, are given at the end of each description. The collection is incorporated in the Herbarium of the University of Cambridge.

ANEMONE RIVULARIS, Ham. Hooker, i. 9. Trimen, i. 3.

Perennial herb. Rootstock stout and woody; leaves thick, silky-pubescent. Near streams above 6000 ft. (696, 6000 ft.)

THALICTRUM JAVANICUM, Blume. Hooker, i. 13. Trimen, i. 3.

A tall, glabrous, perennial herb. Near streams, above 6000 ft. (493, 7000 ft.)

*Ranunculus sagittæfolius*, Hook. Hooker, i. 17. Trimen, i. 4.

Perennial herb. Rhizome ascending; leaves glabrous above, hairy on the veins beneath. In wet places above 6000 ft. (572, 6800 ft.; 571, 7200 ft.)

R. WALLICHIANUS, Wight & Arn. Hooker, i. 20. Trimen, i. 4.

Perennial stoloniferous herb. Leaves hirsute on both surfaces (569, densely hirsute). In wet places above 6000 ft. (570, 6500 ft.; 569, 7000 ft.)

BERBERIS ARISTATA, DC. Hooker, i. 110. Trimen, i. 48.

An erect shrub. Young leaves red; old leaves small and coriaceous. Above 5000 ft. (697, 6000 ft.=C. P. 2405.)

VIOLA PATRINII, DC. Hooker, i. 183. Trimen, i. 66.

Perennial herb. Rootstock woody; leaves radical, thin and glabrous. Common among the long grass above 5000 ft. (760, 5800 ft.)

FLACOURTIA RAMONTCHI, L'Hérit. Hooker, i. 193. Trimen, i. 73.

A tall shrub. Leaves glabrous, semicoriaceous. Locally, at about 4000 ft. (801, 4000 ft.=C.P. 2583.)

*Polygala glaucoides*, Linn., var. *hirsutula*. Hooker, i. 203. Trimen, i. 80.

A small perennial. Taproot stout, fibrous, and very long; rootstock woody; stems decumbent, numerous and wiry; young parts pubescent; leaves small, erect, glabrous and coriaceous. Common above 4000 ft. (843, 5600 ft.; 371, 5800 ft.; 709, 6200 ft.)

P. ROSMARINIFOLIA, Wight & Arn. Hooker, i. 204. Trimen, i. 82.

Annual. Leaves erect, conduplicate, thick, glabrous, with thickened and recurved margins; young leaves densely pubescent. Abundant at about 4000 ft. Also in the dry low country. (769, 3800 ft.; 759, 5600 ft.)

P. TELEPHIOIDES, Willd. Hooker, i. 205. Trimen, i. 82.

A small perennial. Leaves numerous, crowded, erect, thick and glabrous. On the Uva patanas. (428, 3500 ft.; 738, 3800 ft.; 761, 4400 ft.)

CERASTIUM VULGATUM, Linn., var. GLOMERATA. Hooker, i. 228. Trimen, i. 85.

Perennial (?) with a cæspitose habit; all the aerial parts strongly pilose. Common at 6000 ft. in the neighbourhood of Nuwara Eliya. Probably introduced. (383, 5800 ft.; 831, 6200 ft.)

HYPERICUM MYSORENSE, Heyne. Hooker, i. 253. Trimen, i. 93.

A handsome glabrous shrub, attaining 8 ft. Leaves crowded, decussate, semi-erect, glabrous and glazed. Common above 5000 ft. (349, 5800 ft.; 573, 6500 ft.)

H. JAPONICUM, Thunb. Hooker, i. 256. Trimen, i. 93.

Annual. Stems 1 ft., erect or procumbent; leaves few, small, erect or nearly so, glabrous, glandular, rugose, and with recurved margins. In wet places above 5000 ft. (846, 5600 ft.; 348, 5800 ft.)

EURYA JAPONICA, Thunb., var. THUNBERGII. Hooker, i. 284. Trimen, i. 109.

A low gregarious shrub. Leaves semi-erect, conduplicate, glabrous, with red, slightly recurved margins. (728, 5600 ft. =C. P. 787.)

E. CHINENSIS, R. Br. Hooker, i. 285. Trimen, i. 110.

Leaves smaller than in the preceding species. (337, 6200 ft.)

EURYA ACUMINATA, DC., var. WALLICHIANA. Hooker, i. 285. Trimen, i. 110.

Similar in habit to the preceding species. (328, 3800 ft.)

SIDA RHOMBIFOLIA, Linn., var. RETUSA. Hooker, i. 323. Trimen, i. 143.

A low coarse shrub, with few, thin, wrinkled leaves. A common weed. (802, 4000 ft.; 649, 5600 ft.)

TRIUMFETTA RHOMBOIDEA, Jacq. Hooker, i. 395. Trimen, i. 179.

Perennial (?). Leaves thick, pilose below. Rare. (432, 3800 ft.)

OXALIS CORNICULATA, Linn. Hooker, i. 436. Trimen, i. 196.

A stoloniferous perennial. Roots often tuberous; leaflets thin, deeply red-coloured in exposed situations, moving to a profile position in strong sunlight and at night. Common at all elevations. (421, 3800 ft.; 754, 6200 ft.)

*Biophytum proliferum*, Wight. Hooker, i. 438. Trimen, i. 199.

Perennial. Stems wiry, and excessively branched; leaves pinnate, deeply red-coloured in exposed situations; the leaflets move to a profile position in strong sunlight and at night, they are also slightly sensitive to contact. Common above 4000 ft.; often forming extensive mats. (694, 5600 ft.; 234, 5800 ft.)

TODDALIA ACULEATA, Pers. Hooker, i. 497. Trimen, i. 215.

A small erect or climbing shrub. Below 5000 ft. (*Trimen*).

? CIPADESSA FRUTICOSA, Blume. Hooker, i. 545. Trimen, i. 245. (848, 4000 ft.)

? SALACIA RETICULATA, Wight. Hooker, i. 627. Trimen, i. 277.

A small tree. Leaves small, semi-erect, coriaceous and glabrous. Only in one locality on the patanas. (811, 4000 ft.)

*Rhamnus Arnottianus*, Gardn. Hooker, i. 638. Trimen, i. 283.

A small tree. Leaves glabrous and coriaceous. Horton Plains, etc., rare (*Trimen*).

R. WIGHTII, Wight & Arn. Hooker, i. 639. Trimen, i. 283.

A shrub. Leaves glabrous and coriaceous. Above 5000 ft. (293, 5800 ft.)

DODONÆA VISCOSA, Linn. Hooker, i. 697. Trimen, i. 312.

A shrub. Leaves erect, linear-lanceolate, glabrous and viscid. Abundant in a few localities at 4000 ft. (784, 4000 ft.)

ULEX EUROPÆUS, Linn. Trimen, ii. 7.

An introduction. Abundant at 6000 ft., in the neighbourhood of Nuwara Eliya. (334, 6200 ft.)

CROTALARIA PROSTRATA, Roxb. Hooker, ii. 67. Trimen, ii. 9.

Annual. Branches densely fulvous-hairy in the young parts; leaves erect, rather thick, hairy on both surfaces, especially beneath. (217, 3800 ft.; 214, 5600 ft.)

C. FERRUGINEA, R. Grah. Hooker, ii. 68. Trimen, ii. 10.

Perennial (?). Leaves rather thick, pubescent; young leaves and shoots densely villous with yellow hair. Below 4000 ft.; rare. (415, 2200 ft.)

*C. multiflora*, Benth. Hooker, ii. 69, Trimen, ii. 11.

A low perennial. Rootstock woody; stems decumbent, younger parts clothed with dense soft fulvous hair; leaves crowded, erect, subcoriaceous, pubescent on both surfaces. Leaf-movements (?). (417, 2200 ft.; 394, 4000 ft.)

C. RUBIGINOSA, Willd. Hooker, ii. 69. Trimen, ii. 11.

A tall semi-shrubby annual (?). Young parts of the stem densely villous; leaves coriaceous, densely villous on both surfaces, moving to a profile position in bright sunlight and at night. Very common above 4000 ft. (726, 5600 ft.; 242, 5800 ft.)

C. ALBIDA, Heyne. Hooker, ii. 71. Trimen, ii. 12.

A small bush, 1 to 2 ft. Rootstock stout, woody and branched. Leaves semi-erect, linear-spathulate, conduplicate Leaf-movements (?). Very common below 6000 ft. (413, 3000 ft.; 752, 3800 ft.; 813, 4000 ft.; 763, 5600 ft.)

C. NANA, Burm. f. Hooker, ii. 71. Trimen, ii. 13.

A small annual. Branches clothed with dense fulvous silky hair; leaves small, erect, crowded, finely silky on both surfaces. Rare. (339, 5800 ft.)

C. CALYCINA, Schrank. Hooker, ii. 72. Trimen, ii. 14.

An erect herb. Roots very deep; all the aerial parts, except the upper surfaces of the leaves, densely silky with fulvous hair. Very abundant. (416, 2200 ft.; 796, 4000 ft.; 692, 5600 ft.; 274, 5800 ft.)

C. RETUSA, Linn.? Hooker, ii. 75. Trimen, ii. 15.

A small perennial. Rootstock woody; leaves small, crowded, wrinkled, rolled, and densely pubescent below. (419, 2000 ft.)

CROTALARIA VERRUCOSA, Linn. Hooker, ii. 77. Trimen, ii. 15.
The only specimen found on the patanas. A large much-branched annual, probably introduced from the low country. (641, 5600 ft.)

*C. semperflorens,* Vent., var. *Walkeri.* Hooker, ii. 78. Trimen, ii. 16.
A small shrubby perennial. Rootstock stout, woody and branched; branches long and scandent; leaves glabrous, moving into a profile position in bright sunlight. Common at about 6000 ft. (642, 5600 ft.; 278, 5800 ft.)

PAROCHETUS COMMUNIS, Ham. Hooker, ii. 86. Trimen, ii. 20.
A small creeping herb, with trifoliate leaves. Leaf-movements (?). (491, 7000 ft.)

TEPHROSIA TINCTORIA, Pers. Hooker, ii. 111. Trimen, ii. 31.
A semi-shrubby perennial. Young shoots densely clothed with a brown velvety pubescence. Leaflets semi-erect, coriaceous, glabrous above, densely silky beneath. Abundant at 4000 ft. (324, 3800 ft.)

ZORNIA DIPHYLLA, Pers., var. WALKERI. Hooker, ii. 147. Trimen, ii. 35.
A prostrate perennial. Taproot deep; rootstock woody, stems numerous, wiry; leaves petiolate bifoliate; leaflets small, moving into a profile position in bright sunlight. Very abundant at about 4000 ft. (751, 775, 3800 ft.)

SMITHIA BLANDA, Wall. Hooker, ii. 151. Trimen, ii. 37.
A prostrate perennial. Rootstock stout, woody, and branched; leaflets sensitive to contact, and moving into a profile position in bright sunlight and in darkness. Common above 5000 feet. (237, 338, 5800 ft.; 819, 6200 ft.)

PYCNOSPORA HEDYSAROIDES, R.Br. Hooker, ii. 153. Trimen, ii. 41.
Perennial. Stems slender, densely cæspitose, trailing. Leaves pinnately trifoliate. At 3800 ft.

DESMODIUM POLYCARPUM, DC. Hooker, ii. 171. Trimen, ii. 53.
A sub-erect perennial. Rootstock woody; leaves few, trifoliate. (715, 4000 ft.)

D. TRIFLORUM, DC. Hooker, ii. 173. Trimen, ii. 54.
A small perennial. Taproot long and stout; rootstock woody; stems cæspitose, short, and wiry; leaves few and small. Common below 4000 ft. (743, 3800 ft.)

D. PARVIFOLIUM, DC. Hooker, ii. 174. Trimen, ii. 55.
A prostrate perennial. Rootstock woody; stems wiry

densely cæspitose, trailing widely. Leaves crowded; leaflets small, moving into a profile position in bright sunlight. (647, 5600 ft.; 345, 5800 ft.).

PHASEOLUS ADENANTHUS, G. Mey. Hooker, ii. 200. Trimen, ii. 70.

A perennial twiner. (730, 5800 ft.)

P. TRINERVIUS, Heyne. Hooker, ii. 203. Trimen, ii. 72.

A perennial twiner. Rootstock woody; stems with long internodes, villous with brown deflexed hair. Leaflets conduplicate, moving into profile positions in bright sunlight and at night. Common above 5000 ft. (729, 5600 ft.)

P. CALCARATUS, Roxb. (? sp.). Hooker, ii. 203. Trimen, ii. 73.

A small perennial. Stems prostrate. (765, 5600 ft.)

ATYLOSIA CANDOLLEI, Wight & Arn. Hooker, ii. 212. Trimen, ii. 78.

An erect shrub (3–6 ft.). Young branches densely pubescent with yellow hair. Leaves trifoliate; leaflets conduplicate, thick, especially at the margins, densely white tomentose beneath, falling into a profile position in darkness. On emerging from the bud the young leaf is erect, the leaflets being densely clothed with brown silky hair; later, for two or three days, the leaflets hang vertically downwards from the petiole, which remains erect; then the leaflets unfold, and the leaf attains its adult form. Very common between 4000 and 6000 ft. (644, 5600 ft.)

A. RUGOSA, Wight & Arn. Hooker, ii. 215. Trimen, ii. 79.

A straggling perennial. Stems pubescent with yellow hair; leaves trifoliate; leaflets rather thick, softly velvety above, densely so beneath, moving into a profile position in bright sunlight and at night. Common between 3000 and 6000 ft. (645, 5600 ft.; 362, 5800 ft.)

CASSIA KLEINII, Wight & Arn. Hooker, ii. 266. Trimen, ii. 110.

A small, robust, deep-rooted perennial. Rhizome stout; stems numerous and wiry; the leaflets move into a profile position in bright sunlight and at night. Very common in hot stony places below 4000 ft. (424, 2000 ft.; 425, 748, 3800 ft.)

C. MIMOSOIDES, Linn. Hooker, ii. 266. Trimen, ii. 110.

Annual. Stems usually erect. Leaves few; the leaflets move into a profile position in sunlight and at night. Very common at 4000 ft. (773, 3800 ft.; 716, 4000 ft.; 385, 5600 ft.; 714, 5800 ft.)

CASSIA MIMOSOIDES, Linn., var. AURICOMA.

Branches densely clothed with fulvous hair. (877, 4000 ft.)

RUBUS MOLUCCANUS, Linn. Hooker, ii. 330. Trimen, ii. 136.

A scrambling shrub. Leaves simple, thick, subglabrous, tuberculate above, densely ochreous-pubescent beneath; veins deeply sunken on the upper surface, very prominent beneath. Very abundant above 5000 ft. (354, 5800 ft.; 490, 7000 ft.)

R. ELLIPTICUS, Sm. Hooker, ii. 336. Trimen, ii. 137.

A scrambling shrub. Young parts of the stem densely hispid; leaflets semi-erect, conduplicate, glabrous above, with deeply depressed veins, densely grey-pubescent beneath with prominent veins. (395, 4000 ft.; 690, 5600 ft.)

R. LASIOCARPUS, Sm. Hooker, ii. 339. Trimen, ii. 138.

A scrambling shrub. Leaflets glabrous above with depressed veins, grey-pubescent beneath with prominent veins. (240, 5800 ft.)

R. LASIOCARPUS, Sm., var. SUBGLABER, Thw.

Leaflets almost glabrous. (747, 3800 ft.; 689, 5600 ft.)

POTENTILLA MOONIANA, Wight. Hooker, ii. 349. Trimen, ii. 139.

A small prostrate perennial. Rootstock woody; stems prostrate, densely tomentose; leaves chiefly radical, a few distant on the stem, slightly hairy. Above 6000 ft.; rare. (567, 7200 ft.)

P. KLEINIANA, Wight & Arn. Hooker, ii. 359. Trimen, ii. 139.

A small prostrate annual. Stems tomentose, especially in the young parts; leaves sparsely silky-hairy. Above 6000 ft. (566, 7200 ft.)

ALCHEMILLA INDICA, Gardn. Hooker, ii. 361. Trimen, ii. 140.

Perennial. Stems long, prostrate, villous; leaves sparsely pilose above, densely so beneath. Common above 6000 ft. (565, 7200 ft.)

*Agrimonia zeylanica*, Moon. Hooker, ii. 362. Trimen, ii. 141.

A tall perennial. Rootstock woody; stems and leaves villous-hairy; leaflets conduplicate, margins red-coloured. Above 4000 ft.; common. (691, 5600 ft.; 246, 5800 ft.)

BRYOPHYLLUM CALYCINUM, Salisb. Hooker, ii. 413. Trimen, ii. 145.

Common at Wilson's Bungalow (4000 ft.). "A common plant on bare rocky places throughout the low and lower montane country, and has all the look of a native" (*Trimen*).

KALANCHOE FLORIBUNDA, Wight & Arn. Hooker, ii. 414. Trimen, ii. 144.

Perennial. Leaves glabrous and succulent. At 4000 ft. and 5600 ft. (*Nock*).

DROSERA BURMANNI, Vahl. Hooker, ii. 424. Trimen, ii. 145.

Leaves rosulate, the living ones resting on a mat formed of old leaf-remains. In wet places at all elevations. (414, 3800 ft.; 283, 5800 ft.; 850, 6200 ft.)

D. PELTATA, Sm. Hooker, ii. 424. Trimen, ii. 146.

The stem (6 to 10 inches) arises from a deeply-situated, smooth, red tuber; the lamina of the peltate leaf is fixed in a vertical plane on the horizontal petiole. Very common above 5000 ft. (829, 5600 ft.; 661, 6000 ft.)

SERPICULA INDICA, Thw. Hooker, ii. 431. Trimen, ii. 148.

A prostrate herb, often forming dense mats in wet places. Very common above 5000 ft. (379, 5800 ft.; 872, 6200 ft.; 489, 7200 ft.; 356, 8000 ft.)

CARALLIA INTEGERRIMA, DC. Hooker, ii. 439. Trimen, ii. 155.

A tree. Young leaves red-coloured; old leaves semi-erect and semi-coriaceous. The only specimen seen on the patanas. At 4000 ft.

PSIDIUM GUYAVA, Linn. Hooker, ii. 468. Trimen, ii. 167.

A small tree. Young leaves erect, densely pubescent, conduplicate. Naturalized; rare on the patanas. (800, 4000 ft.)

RHODOMYRTUS TOMENTOSA, Wight. Hooker, ii. 469. Trimen, ii. 166.

A shrub. Young shoots and leaves densely pubescent; leaves erect, rigidly coriaceous, glabrous above, finely pubescent beneath, with recurved margins. Aromatic. Above 5000 ft. "At Malacca I found this abundantly on the sandy seashore, but in Ceylon it is entirely a montane plant" (*Trimen*). (239, 5800 ft.)

*Eugenia olivifolia*, Duthie. Hooker, ii. 495. Trimen, ii. 178.

A small, much-branched tree. Young leaves red; old leaves erect, glabrous, coriaceous. Rare on the patanas. (805, 4000 ft.)

E. JAMBOLANA, Lam. (? sp.). Hooker, ii. 499. Trimen, ii. 179. (879, 3800 ft.)

E. (? sp.).—(438, 2200 ft.)

Careya arborea, Roxb. Hooker, ii. 511. Trimen, ii. 191.

The "Patana Oak": a small tree, with glabrous coriaceous leaves. "The heart-wood is dark reddish-brown, heavy, moderately hard, even-grained, very durable. The bark is very astringent. The inner bark gives a strong fibre" (*Trimen*). Very abundant below 4500 ft. "Also rarely in the dry region" (*Trimen*). (771, 3800 ft.; 789, 4000 ft.)

Osbeckia cupularis, D. Don, var. erythrocephala. Hooker, ii. 514. Trimen, ii. 194.

A low shrub, often growing gregariously. Rootstock woody; stems prostrate or decumbent, young parts densely fulvous-hairy; leaves semi-erect, conduplicate, often red, densely hairy. Very abundant above 5000 ft. (711, 5600 ft.; 235, 5800 ft.; 841, 6200 ft.; 568, 7200 ft.)

O. aspera, Blume, var. Kleinii. Hooker, ii. 519. Trimen, ii. 195.

A low shrub. Rootstock stout and woody; young shoots hispid and purple-coloured, semi-succulent; leaves conduplicate, pilose on both surfaces. (433, 2200 ft.)

*O. rubicunda*, Arn. Hooker, ii. 520. Trimen, ii. 197.

A low shrub. Rootstock stout and woody; leaves hispid on both surfaces. Abundant above 4000 ft. (883, 4000 ft.; 651, 887, 5600 ft.)

O. octandra, DC. Hooker, ii. 521. Trimen, ii. 198.

A small erect shrub. Young shoots hispid; leaves coriaceous, glabrous or slightly hairy. Abundant below 5000 ft. (435, 2200 ft.; 434, 3800 ft.; 710, 5600 ft.)

Woodfordia floribunda, Salisb. Hooker, ii. 572. Trimen, ii. 226.

A straggling shrub. Leaves finely pubescent above, densely so and glandular beneath, with recurved margins. Locally abundant at 4000 ft.; otherwise rare. (806, 4000 ft.)

Mukia scabrella, Arn. Hooker, ii. 623. Trimen, ii. 254.

A perennial herbaceous climber. Leaves rough scabrid above, roughly hispid beneath. (777, 3800 ft.)

Rhipsalis Cassytha, Gaertn. Hooker, ii. 658. Trimen, ii. 266.

Perennial. Stem succulent; leaves reduced to scales. On rocks above 5000 ft.; rare. (396, 5600 ft.)

Hydrocotyle asiatica, Linn. Hooker, ii. 669. Trimen, ii. 276.

A prostrate perennial. Rootstock erect; stems long and trailing, with long internodes. Very abundant above 5000 ft. (393, 5800 ft.)

BUPLEURUM MUCRONATUM, Wight & Arn., var. VIRGATA. Hooker, ii. 676. Trimen, ii. 277.

Perennial. Stem erect; leaves semi-erect, linear, with red-coloured margins. Very abundant above 5000 ft. (830, 5600 ft.; 653, 6000 ft.; 564, 7000 ft.)

PIMPINELLA LESCHENAULTII, DC. Hooker, ii. 687. Trimen, ii. 279.

Perennial. Rootstock branched; leaves coriaceous, chiefly radical, finely pubescent beneath. On the patanas at 7000 ft.—the only locality in Ceylon. (609, 7000 ft.)

*Heracleum ceylanicum*, Gardn. Hooker, ii. 716. Trimen, ii. 280.

Perennial. Rootstock ascending, stout and woody; roots thick and tuberous; leaves pubescent on both surfaces. Common above 5000 ft. (827, 5600 ft.; 243, 5800 ft.; 361, 7000 ft.)

HEPTAPLEURUM STELLATUM, Gaertn. Hooker, ii. 730. Trimen, ii. 283.

A scandent shrub. Young leaflets red and hanging vertically; old leaves coriaceous and glabrous. In sheltered localities below 4000 ft. (871, 3800 ft.)

WENDLANDIA NOTONIANA, Wall. Hooker, iii. 40. Trimen, ii. 297.

A tall shrub. Old leaves coriaceous and glabrous; young leaves erect, red, and hairy. Below 4000 ft. (448, 750, 3800 ft.)

*Allæophania decipiens*, Thw. Hooker, iii. 48. Trimen, ii. 301.

A small coarse shrub. Leaves roughly hairy above, silky pubescent on the prominent veins beneath, especially when young. (873, 5800 ft.)

HEDYOTIS VERTICILLARIS, Wight & Arn. Hooker, iii. 56. Trimen, ii. 311.

A large perennial herb, with gregarious aloe-like habit. Rootstock stout; roots very long, superficial and woody; stem very short; leaves radical, the younger ones erect, and forming a cup in which water collects, the lower ones rosulate; stipules erect, lanceolate, bearing numerous marginal glands. The old leaf-remains form a rotting mass around the bases of the younger leaves. Very abundant in wet places above 6000 ft. (245, 6200 ft.)

*H. Lawsoniæ*, Wight & Arn. Hooker, iii. 56. Trimen, ii. 310.

A small shrub, often growing gregariously; leaves erect, glabrous, glazed, coriaceous, with recurved margins. Abundant above 5000 ft., often forming the principal constituent of the vegetation on the boundary between the patana and the forest. (698, 6200 ft.)

OLDENLANDIA HEYNEI, R. Br. Hooker, iii. 65. Trimen, ii. 315.

A small much-branched annual, with a stout taproot. Stems glabrous and wiry, with long internodes; leaves small, linear, glabrous, and usually rolled. Very abundant at 4000 ft. and below. (451, 2000 ft.; 449, 3800 ft.; 808, 717, 4000 ft.)

*Anotis nummularia*, Arn. Hooker, iii. 75. Trimen, ii. 318.

A small prostrate perennial; stem hairy, rooting at the nodes; leaves erect, thick, hairy on both surfaces. Common in wet places above 5000 ft. (365, 5800 ft.)

MUSSÆNDA FRONDOSA, Linn., var. ZEYLANICA. Hooker, iii. 89. Trimen, ii. 323.

A small shrub. Young branches and the leaves softly velvety, especially beneath; young leaves densely pilose. Rare on the patanas. (793, 4000 ft.)

KNOXIA CORYMBOSA, Willd. Hooker, iii. 128. Trimen, ii. 340.

An erect annual. Stem tomentose, densely so in the young parts, internodes long; leaves pubescent, especially on the lower surface. Rare on the patanas. (505, 2500 ft.)

K. MOLLIS, Wight & Arn. Hooker, iii. 129. Trimen, ii. 340.

A small shrubby annual, almost glabrous. Rare. (658, 5600 ft.)

*K. platycarpa*, Arn. Hooker, iii. 131. Trimen, ii. 341.

A small bush, 1 to 3 feet high. Rootstock horizontal, woody and branched; young stems and petioles purple-coloured; leaves erect or semi-erect, coriaceous, glabrous or nearly so, often rugose, with recurved margins; young leaves erect and hairy. Very abundant, particularly above 5000 ft., where it often forms an important constituent of the border-vegetation between patana and forest. One of the first plants to reappear after a patana-fire. (453, 2200 ft.; 455, 3000 ft.; 391, 4000 ft.; 659, 5600 ft.)

*K. platycarpa*, Arn., var. *hirsuta*.

The whole plant more or less hairy. In No. 484 the hairiness extends to the upper surfaces of the leaves (*cf.* Trimen). Abundant on the patanas, particularly at 4000 ft., where it is more common than the type. (778, 3800 ft.; 699, 5600 ft.; 343, 5800 ft.; 484, 7000 ft.)

*K. platycarpa*, Arn., var. *foliosa*, Thw. (343, 5800 ft.)

CANTHIUM RHEEDI, DC., var. MINUS, Thw. Hooker, iii. 134. Trimen, ii. 344. (=C. P. 3420.)
(212, 3800 ft.)

C. PARVIFLORUM, Lam. Hooker, iii. 136. Trimen, ii. 346.
A shrub. "Wood very hard and close-grained" (*Trimen*). Leaves glabrous and semi-coriaceous. Below 5000 ft.; rare. (803, 4000 ft.)

? MORINDA TINCTORIA, Roxb. Hooker, iii. 156. Trimen, ii. 354.
(447, 2200 ft.)

RUBIA CORDIFOLIA, Linn. Hooker, iii. 202. Trimen, ii. 372.
A long scandent perennial. "Roots very long, with a thick red cortex" (*Trimen*). Leaves rugose, semi-coriaceous. (683, 5600 ft.)

GALIUM MOLLUGO, Linn. Hooker, iii. 207. Trimen, ii. 373.
Very abundant among the grasses of the patanas above 5000 ft. (682, 5600 ft.; 376, 5800 ft.; 485, 7000 ft.)

*Valeriana Moonii*, Arn. Hooker, iii. 213. Trimen, iii. 1.
A tall perennial. Rootstock horizontal; roots numerous and long. In wet places at high elevations. (483, 7000 ft.)

*Dipsacus Walkeri*, Arn. Hooker, iii. 218. Trimen, iii. 2.
A tall perennial. Rootstock stout and woody; leaves mostly radical. In wet places at high elevations. Rather rare. (562, 7000 ft.)

*Vernonia Thwaitesii*, C. B. Clarke. Hooker, iii. 231. Trimen, iii. 6.
Perennial. Rootstock woody; roots numerous, stout, and fibrous; leaves erect, sub-glabrous, semi-coriaceous. On the wet patanas. Very rare. (393, 4400 ft.)

V. CINEREA, Less. Hooker, iii. 133. Trimen, iii. 7.
A small annual. (476, 3800 ft.)

*V. setigera*, Arn. (sp. ?). Hooker, iii. 235. Trimen, iii. 7.
A small undershrub. (634, 5600 ft.)

*V. Wightiana*, Arn. Hooker, iii. 238. Trimen, iii. 9.
A low undershrub, usually 2 to 3 feet; on the dry patanas; 8 feet. Rootstock stout and woody; taproot woody and deep; lower surfaces of the leaves and the young shoots densely tomentose. Very abundant on the patanas, especially at about 2500 ft., where it frequently forms a dense scrub. (468, 2500 ft.; 469, 3800 ft.; 822, 5600 ft.; 244, 5800 ft.; 840, 6200 ft.; 561, 7000 ft.)

ELEPHANTOPUS SCABER, Linn. Hooker, iii. 242. Trimen, iii. 12.

A perennial weed. Rootstock woody; roots long and fibrous; leaves radical, rugose and scabrous. At about 4000 ft. (470, 3800 ft.)

DICHROCEPHALA LATIFOLIA, DC. Hooker, iii. 245. Trimen, iii. 14.

An annual weed. Abundant above 5000 ft. (665, 5600 ft.)

MYRIACTIS WIGHTII, DC. Hooker, iii. 247. Trimen, iii. 15.

A small perennial (?). Rootstock woody; leaves radical. Above 5000 ft. (492, 7000 ft.)

LAGENOPHORA BILLARDIERI, Cass. Hooker, iii. 248. Trimen, iii. 16.

The "Patana Daisy"; a small perennial herb. Rootstock short and erect; roots numerous, deep, and tuberous; leaves radical. Very abundant above 5000 ft.; one of the earliest plants to reappear after a patana-fire. 823, 5600 ft., and at 3800 ft.

MICROGLOSSA ZEYLANICA, Benth. Hooker, iii. 257. Trimen, iii. 17.

An erect shrub, 2–8 feet; leaves coriaceous, hoary below, scabrous above. Very abundant between 2000 and 3000 ft. (786, 4000 ft.; 686, 5600 ft.)

BLUMEA LACERA, DC. Hooker, iii. 263. Trimen, iii. 19.

Annual. Roots numerous, long and fibrous; young shoots and leaves densely hirsute; old leaves glabrous above, rugose. Above 5000 ft. (685, 5600 ft.)

*B. crinita*, Arn. Hooker, iii. 267. Trimen, iii. 21.

A small shrubby perennial. Rootstock horizontal and woody; roots long and fibrous; young aerial parts densely hirsute; old leaves sparsely hairy or glabrous above. In wet places above 6000 ft. (384, 839, 6200 ft.)

B. FLEXUOSA, C. B. Clarke. Hooker, iii. 267. Trimen, iii. 20.

A small shrubby perennial. Rootstock horizontal, stout and woody; roots long and fibrous; stem softly hairy; leaves woolly beneath, pubescent to glabrescent above. Faintly aromatic. Particularly abundant at 6000 ft. (472, 2500 ft.; 471, 3500 ft.; 239, 5800 ft.)

LAGGERA ALATA, Schultz-Bip. Hooker, iii. 271. Trimen, iii. 23.

Perennial. Leaves crowded, semi-erect, tomentose to pubescent beneath, pubescent above. Strongly aromatic. Abundant at 4000 ft. (638, 5600 ft.)

**Anaphalis cinnamomea**, C. B. Clarke. Hooker, iii. 281. Trimen, iii. 28.

Perennial. Stems woody at the base, covered with old leaf-remains, lanate in the younger parts; leaves linear, densely cinnamomeous-woolly beneath, white-grey floccose above, with recurved margins. Above 6000 ft. (560, 7000 ft.)

**A. oblonga**, DC. Hooker, iii. 283. Trimen, iii. 30.

Perennial. Taproot stout; stem erect, floccose; leaves mostly radical, linear, lanate on both surfaces, with recurved margins, dead remains persisting. Abundant everywhere, particularly at and below 4000 ft. (474, 2000 ft.; 810, 4000 ft.; 277, 5800 ft.; 557, 6000 ft.)

*A. Thwaitesii*, C. B. Clarke. Hooker, iii. 284. Trimen, iii. 29.

A low shrub. Roots fibrous, woody, and very long; stem woody and leafless below, lanate above; leaves densely crowded on the upper part of the stem, small, oblong, conduplicate or rolled, densely lanate. At the highest elevations; very rare. (359, 8000 ft.)

*A. zeylanica*, C. B. Clarke. Hooker, iii. 286. Trimen, iii. 30.

Perennial. Root-system shallow; stems slender, decumbent, leafless below, lanate above; leaves crowded on the upper part of the stem, erect, densely lanate on both surfaces (nearly glabrous in 637), with recurved margins.

No. 357 is Thwaites' Form 2, *vide* Fl. Br. Ind. loc. cit. Abundant above 5000 ft. (350, 5800 ft.; 357, 637, 8000 ft.)

**A. marcescens**, C. B. Clarke. Hooker, iii. 286. Trimen, iii. 31.

Perennial. Rootstock erect, stout and woody; stem decumbent, woody below, floccose above; leaves narrow, linear, semi-erect, fulvous-lanate below, grey-floccose above, with recurved margins. Very abundant above 5000 ft., especially where the humus is shallow. (276, 5800 ft.; 835, 6200 ft.; 558, 7000 ft.; 358, 8000 ft.)

**A. brevifolia**, DC. Hooker, iii. 286. Trimen, iii. 31.

Perennial. Root-system shallow; stems decumbent, tomentose; leaves crowded, semi-erect, narrow, linear-oblong, tomentose on both surfaces, with recurved margins. Very abundant above 5000 ft., especially where the humus is deep. At 7000 ft. the plant is dwarfed and much more branched than at lower elevations. (344, 5800 ft.; 836, 6200 ft.)

**HELICHRYSUM BUDDLEIOIDES**, DC. Hooker, iii. 290. Trimen, iii. 32.

A semi-shrubby perennial; stems densely lanate; leaves glabrous above, densely white-tomentose beneath, with recurved margins. At 6000 ft. (*Trimen*).

? **CHRYSOGONUM HETEROPHYLLUM**, Benth. Hooker, iii. 303. Trimen, iii. 34.

Perennial. (635, 5600 ft.)

*Gynura Pseudo-china*, DC., *var. hispida*. Hooker, iii. 335. Trimen, iii. 45.

A stout biennial (?) herb. Root tuberous and very long; young shoots and leaves densely strigose; leaves crowded. On rocks. (477, 2200 ft.; 825, 5600 ft.)

*Emilia zeylanica*, C. B. Clarke. Hooker, iii. 336. Trimen, iii. 46.

A erect perennial. Rootstock woody; roots long, fibrous; leaves semi-erect, semi-coriaceous, glabrous, with recurved margins. Common about 6000 ft. (475, 2000 ft.; 666, 5600 ft.; 355, 5800 ft.; 815, 6000 ft.)

**SENECIO ZEYLANICUS**, DC. Hooker, iii. 340. Trimen, iii. 48.

Perennial. Rootstock woody; roots long and fibrous; stem decumbent, leafless below; leaves crowded, linear, glabrous, thick and strongly recurved. Young leaves and shoots often coloured brown-red. Abundant above 5000 ft. (346, 5800 ft.)

**S. LUDENS**, C. B. Clarke. Hooker, iii. 345. Trimen, iii. 49.

A straggling perennial. Rootstock erect and woody; leaves rather thick, rugose, or scabrid. Abundant in wet places above 4000 ft.

**CREPIS FUSCIPAPPA**, C. B. Clarke. Hooker, iii. 395. Trimen, iii. 51.

A glabrous perennial. Above 5000 ft.; rare. (684, 5600 ft.; 378, 5800 ft.)

**TARAXACUM OFFICINALE**, Wigg. Hooker, iii. 401. Trimen, iii. 51.

An introduction from the Hakgala Botanic Gardens, which is spreading widely over the patanas. (5600 ft.)

**LOBELIA NICOTIANÆFOLIA**, Heyne. Hooker, iii. 427. Trimen, iii. 57.

A tall perennial. Stems 5–12 ft., erect, thick, usually unbranched, naked below. Leaves thin, pubescent beneath. Young leaves semi-erect and hairy. Abundant on the patanas above 5500 ft., particularly near Nuwara Eliya; usually near streams. Rare below 5000 ft. (467, 3800 ft.)

**WAHLENBERGIA GRACILIS**, DC. Hooker, iii. 429. Trimen, iii. 58.

Perennial. Rootstock stout and woody. Stems numerous, decumbent, wiry, leafless below; leaves few, small, semi-erect, more or less hairy, wrinkled, with recurved margins. Extremely abundant above 4000 ft. (466, 3000 ft.; 380, 5800 ft.; 482, 7200 ft.)

**CAMPANULA FULGENS**, Wall. Hooker, iii. 442. Trimen, iii. 60.

Perennial. Rootstock short and twisted; roots fusiform; leaves few, mostly near the base of the stem. On the patanas at high elevations; rare (*Trimen*).

? **VACCINIUM LESCHENAULTII**, Wight, var. ZEYLANICA. Hooker, iii. 455. Trimen, iii. 61.

A shrub. Young leaves red and hanging; old leaves coriaceous. (863, 3800 ft.)

**GAULTHERIA FRAGRANTISSIMA**, Wall. Hooker, iii. 457. Trimen, iii. 62.

A low shrub, often with a cæspitose habit. Rhizome woody; leaves small, semi-erect, coriaceous and glabrous, with recurved margins, faintly aromatic; young leaves deeply red-coloured. A specimen gathered in the forest (No. 487) is much taller and has much larger leaves than patana-specimens from the same elevation. Common above 5500 ft. (847, 6000 ft.; 486, 7200 ft.)

**RHODODENDRON ARBOREUM**, Sm., var. NILAGIRICUM. Hooker, iii. 461. Trimen, iii. 63.

A small tree. Leaves very thick and coriaceous, glabrous above, clothed by ferruginous hairs beneath, with strongly recurved margins. Young leaves semi-erect, densely covered on both surfaces with flocculent wax. The corolla-tubes are almost invariably bored through at the base by insects, as has been shown to be the case in *R. hirsutum* and *R. ferrugineum* on the European Alps (56). Very abundant above 5000 ft.

**LYSIMACHIA DELTOIDEA**, Wight, var. CORDIFOLIA. Hooker, iii. 505. Trimen, iii. 66.

Perennial. Stem prostrate, tomentose; leaves erect, pubescent on both surfaces. About 5500 ft.; rare. (238, 5800 ft.; 535, 7200 ft.)

MYRSINE CAPITELLATA, Wall., var. LANCEOLATA. Hooker, iii. 512. Trimen, iii. 68.

A shrub. Leaves erect, smaller than in the type, coriaceous and glabrous. (790, 4000 ft.)

EMBELIA VIRIDIFLORA, Scheff. Hooker, iii. 516. Trimen, iii. 70.

A large scandent shrub. Leaves few, simple, coriaceous and glabrous. On the dry patanas; rare. (804, 4000 ft.)

*Ardisia Gardneri*, C. B. Clarke. Hooker, iii. 512. Trimen, iii. 72.

A forest undershrub. Leaves coriaceous and glabrous. Above 5000 ft., usually near the edge of the forest. (886, 5600 ft.)

JASMINUM ANGUSTIFOLIUM, Vahl. Hooker, iii. 598. Trimen, iii. 114.

A low shrub. Rootstock stout, woody, and much branched. Leaves small, simple, numerous, and glabrous. On the dry patanas; rare. (788, 4000 ft.)

LIGUSTRUM WALKERI, Decne. Hooker, iii. 614. Trimen, iii. 119.

A shrub. Leaves semi-erect, semi-coriaceous; young leaves red. Common below 4000 ft. (795, 4000 ft.)

*Exacum Walkeri*, Arn. Hooker, iv. 96. Trimen, iii. 180.

Biennial or perennial. Leaves few, small, semi-succulent. About 6000 ft.; rare. (849, 6200 ft.)

*E. zeylanicum*, Roxb. Hooker, iv. 97. Trimen, iii. 181.

Biennial or perennial. Roots and stem-base stout and woody; leaves semi-erect, numerous, thin, glabrous. Common on the patanas at all elevations. (437, 2200 ft.; 791, 4000 ft.; 838, 5600 ft.; 364, 5800 ft.)

*E. zeylanicum*, Roxb., var. *macrantha*. (706, 5600 ft.)

GENTIANA QUADRIFARIA, Blume. Hooker, iv. 111. Trimen, iii. 186.

Biennial (?). A small decumbent herb. Leaves semi-erect, crowded, glabrous, semi-succulent. Common above 5000 ft. The patana-plants show the dwarfed, much branched stems covered with closely-set leaves which are characteristic of the "Sun" form of this species *. (282, 5800 ft.; 848, 6200 ft.)

*Swertia zeylanica*, Walker. Hooker, iv. 127. Trimen, iii. 187.

Perennial (?). Leaves semi-erect, few, small and semi-succulent, conduplicate. Young parts of the stem and edges of the leaves (sometimes the whole leaves) are red-coloured. Very abundant above 5000 ft. (727, 5600 ft.; 231, 5800 ft.; 546, 6000 ft.)

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* Schimper, 'Pflanzen Geographie,' p. 766, fig. 425 (1 & 2).

**CYNOGLOSSUM FURCATUM**, Wall., var. **LANCEOLATUM**. Hooker, iv. 156. Trimen, iii. 203.

Perennial. A tall coarse weed; leaves tuberculate, shortly pilose on the veins beneath. The blue colour of the flowers is more intense at 7000 ft. than at lower elevations. (704, 5600 ft.)

**ARGYREIA HIRSUTA**, var. **COACTA**, C. B. Clarke. Hooker, iv. 189. Trimen, iii. 206.

A semi-shrubby twiner. Stems long, stout, and hairy; leaves conduplicate, silky-hairy on both surfacs. Above 4000 ft.; rare. (891, 4000 ft.)

**EVOLVULUS ALSINOIDES**, Linn. Hooker, iv. 220. Trimen, iii. 227.

A small prostrate perennial. Roots long and much branched: rootstock woody and branched; stems long, spreading, silky-hairy; leaves small, few, erect, conduplicate, silky-hairy on both surfaces. Very abundant below 4000 ft. (442, 3800 ft.; 794, 4000 ft.)

**SOLANUM INDICUM**, Linn. Hooker, iv. 234. Trimen, iii. 234.

A weedy shrub. Leaves and young stems densely tomentose. (776, 3800 ft.; 321, 5600 ft.)

**VERBASCUM THAPSUS**, Linn. Hooker, iv. 250. Trimen, iii. 241.

The common English "Mullein." This plant has become naturalized on the patanas in the neighbourhood of Nuwara Eliya, where it is very abundant, and has the characteristic British habit.

**TORENIA HIRTELLA**, Hook. f. Hooker, iv. 277. Trimen, iii. 249.

A small herb, with long internodes, prostrate among the grasses. Leaves few, small, and wrinkled. (702, 5600 ft.)

**STRIGA LUTEA**, Lour. Hooker, iv. 299. Trimen, iii. 256.

A small, erect, herbaceous root-parasite. Leaves few, erect, small, linear. Very abundant below 6000 ft. (740, 3800 ft.)

**S. EUPHRASIOIDES**, Benth. Hooker, iv. 299. Trimen, iii. 256.

Rather taller than the last species. Stem and leaves red-coloured. Very abundant below 4000 ft. (458, 3000 ft.; 741, 3800 ft.)

**SOPUBIA TRIFIDA**, Ham. Hooker, iv. 302. Trimen, iii. 257.

An erect annual. Leaves trifid, or entire, filiform, borne on axillary short shoots; young leaves brown-red. Very abundant everywhere. (445, 2200 ft.; 443, 3000 ft.; 381, 5800 ft.; 881, 6200 ft.)

**PEDICULARIS ZEYLANICA**, Benth. Hooker, iv. 317. Trimen, iii. 260.

Perennial. Rootstock woody; roots tuberous; leaves mostly radical, a few smaller ones higher up the stem, semi-erect, glabrous above, pubescent beneath with recurved margins. Abundant above 5000 ft. One of the earliest plants to reappear after a patana-fire. (821, 5600 ft.; 563, 7200 ft.)

[Specimens of *Utricularia* sp. were so badly preserved that identification is in several cases impossible. The following were all found in marshy hollows at the elevations indicated.]

**UTRICULARIA CŒRULEA**, Linn. Hooker, iv. 331. Trimen, iii. 268.

A common species. (459, 3000 ft.; and at 6200 ft.)

**U. BIFIDA**, Linn. Hooker, iv. 332. Trimen, iii. 270.

(461, 3000 ft.)

**U. RACEMOSA**, Wall. Hooker, iv. 333. Trimen, iii. 270.

(463, 3000 ft.)

**U. ORBICULATA**, Wall. Hooker, iv. 334. Trimen, iii. 271.

(462, 3000 ft.)

*Didymocarpus Humboldtiana*, Gardn. Hooker, iv. 253. Trimen, iii. 273.

A small perennial. Rootstock short, stout and erect; leaves radical, densely tomentose beneath, hirsute above. On wet boulders between 5000 and 6000 ft. (762, 5600 ft.)

**JUSTICIA PROCUMBENS**, Linn. Hooker, iv. 539. Trimen, iii. 337.

A small stoloniferous perennial. Stems decumbent, usually with long internodes; leaves small, wrinkled, with recurved margins. Common among the grasses above 5000 ft. (701, 5600 ft.; 842, 6200 ft.)

**LANTANA** sp. (3000 ft.; 3800 ft.)

*Premna Thwaitesii*, C. B. Clarke. Hooker, iv. 579. Trimen, iii. 353.

A small tree. Young parts densely pubescent; leaves densely pubescent beneath; strongly aromatic. Near Wilson's Bungalow; rare. (*Trimen.*)

**GENIOSPORUM ELONGATUM**, Benth. Hooker, iv. 610. Trimen, iii. 368.

A tall perennial. Rootstock woody; stem with long internodes; leaves few, erect, conduplicate, small, pubescent on both sides. Abundant at about 4000 ft. (457, 3000 ft.; 755, 5600 ft.)

*Plectranthus nigrescens*, Benth. Hooker, iv. 617. Trimen, iii. 370. (779, 6200 ft.)

P. MENTHOIDES, Benth. Hooker, iv. 620. Trimen, iii. 372.

A tall perennial, semi-shrubby below. Young stem and both surfaces of the leaves densely pubescent; strongly aromatic. Locally abundant above 4000 ft. (389, 5600 ft.)

COLEUS BARBATUS, Benth. Hooker, iv. 625. Trimen, iii. 373.

Perennial. Stems semi-succulent; the whole plant densely pubescent and strongly aromatic. Locally abundant at 4000 ft. (399, 3800 ft.)

C. MALABARICUS, Benth. Hooker, iv. 626. Trimen, iii. 374.

Perennial. Stem stout and succulent; leaves thin and wrinkled. Rare on the patanas. (617, 6000 ft.)

*Pogostemon reflexus*, Benth. Hooker, iv. 633. Trimen, iii. 378.

A small shrub. Young stems and leaves densely pubescent; aromatic. At high elevations; rare. (612, 7000 ft.)

CALAMINTHA UMBROSA, Benth. Hooker, iv. 650. Trimen, iii. 381.

Perennial. Stem decumbent, leafless below; leaves few, small, semi-coriaceous. Abundant among the grass above 5000 ft. (289, 5800 ft.)

LEUCAS MARRUBIOIDES, Desf. Hooker, iv. 683. Trimen, iii. 385.

Perennial. Stem semi-woody, leafless below, tomentose above; leaves thick, velvety-hairy above; densely white-tomentose beneath. (456, 2200 ft.; 785, 4500 ft.; 758, 5600 ft.)

L. ZEYLANICA, R. Br., var. WALKERI. Hooker, iv. 689. Trimen, iii. 387.

Annual. Stem long, decumbent or erect, leafless below, young parts pubescent. Leaves few, linear, rolled, densely pubescent on both surfaces. Abundant above 4000 ft. (719, 4000 ft.; 703, 5600 ft.)

PLANTAGO LANCEOLATA, Linn. Hooker, iv. 706. Trimen, iii. 389.

Annual. An introduction, which has established itself on the patanas in the neighbourhood of Nuwara Eliya. (837, 6200 ft.)

POLYGONUM ALATUM, Ham., var. PARVIFLORA. Hooker, v. 41. Trimen, iii. 413.

Annual. Stems numerous, prostrate, spreading, semi-succulent, purple, with long internodes; leaves small, purple when young. Very abundant above 5000 ft. (336, 5800 ft.; 575, 7200 ft.)

POLYGONUM CHINENSE, Linn. Hooker, v. 44. Trimen, iii. 413.

A long trailing shrubby perennial; young stem, petiole, and ochrea red-coloured; leaves rather thick, glabrous, with recurved margins. Abundant above 5000 ft. (845, 5600 ft.)

PEPEROMIA REFLEXA, A. Dietr. Hooker, v. 99. Trimen, iii. 432.

A small perennial with small tufted succulent leaves. On boulders above 5000 ft. (401, 5500 ft.)

*Actinodaphne stenophylla,* Thw. Hooker, v. 150. Trimen, iii. 446.

A small tree (20 ft.). Leaves erect, small, glabrous and coriaceous; young leaves densely pubescent with dark brown hairs. Locally plentiful. (412, 2200 ft.; 326, 3800 ft.; 812, 4000 ft.)

LITSEA ZEYLANICA, Nees. Hooker, v. 178. Trimen, iii. 454.

A small tree. Leaves semi-erect, glabrous and coriaceous; young leaves erect and red-coloured. In sheltered hollows at about 4000 ft. (327, 3800 ft.)

WIKSTROEMIA CANESCENS, Meissn. Hooker, v. 195. Trimen, iii. 458.

A small shrub; leaves crowded at the top of the shoot, erect, thin, faintly pubescent, with recurved margins. Above 5000 ft.; rare. (295, 5800 ft.)

LASIOSIPHON ERIOCEPHALUS, Decne, var. ZEYLANICUS, Meissn. Hooker, v. 197. Trimen, iii. 459.

An erect shrub. Leaves crowded, erect, silky-villous, particularly on the lower surface. Young leaves densely villous on both surfaces. Abundant at 4000 ft. (783, 4000 ft.)

LORANTHUS SUBORBICULARIS, Thw. Hooker, v. 214. Trimen, iii. 466.

Epiphytic on the Rhododendron. Leaves semi-erect, thick and coriaceous. (1247, 6200 ft.)

OSYRIS ARBOREA, Wall. Hooker, v. 232. Trimen, iii. 474.

A small shrub. Leaves small, crowded, erect, glabrous and coriaceous. Young leaves red-coloured. Very abundant below 6000 ft. (402, 2200 ft.; 744, 3800 ft.; 787, 4000 ft.; 554, 5600 ft.)

**EUPHORBIA ROTHIANA**, Spreng. Hooker, v. 263. Trimen, iv. 8.

A semi-shrubby perennial. Leaves crowded and erect; young leaves red. (746, 3800 ft.; 285, 5800 ft.; 360, 7000 ft.)

**PHYLLANTHUS EMBLICA**, Linn. Hooker, v. 289. Trimen, iv. 19.

A small tree. Leaves numerous, crowded, deciduous in the dry season. Abundant below 4000 ft. (*Trimen.*)

**P. SIMPLEX**, Retz. Hooker, v. 295. Trimen, iv. 22.

A spreading perennial. Rootstock stout and woody; roots woody and deep; stems numerous and wiry; leaves small, glabrous, with thickened, red, and recurved margins, moving into a profile position in bright sunlight and at night. Very common above 5000 ft. This and its variety are among the first plants to reappear after a patana-fire. (721, 4000 ft.; 816, 5600 ft.; 876, 5800 ft.)

**P. SIMPLEX**, Retz., var. **GARDNERIANUS**, Muell. Arg.

(742, 3800 ft.; 301, 5800 ft.; 488, 7000 ft.)

**GLOCHIDION ZEYLANICUM**, A. Juss. Hooker, v. 310. Trimen, iv. 28.

A small tree with red buds. Leaves erect, glabrous on both sides (pubescent beneath in var. *tomentosum*), very thick and coriaceous. Young leaves hanging and red-coloured. Rare. (869, 3800 ft.; 798, 4000 ft.)

*G. coriaceum*, Thw. Hooker, v. 321. Trimen, iv. 30.

A shrub. Leaves erect, glabrous, thick and coriaceous; young leaves hairy. Rare. (881, 3800 ft.)

*G. montanum*, Thw. Hooker, v. 325. Trimen, iv. 31.

A small tree. Leaves coriaceous, glabrous above, pubescent beneath. Rare. (*Trimen.*)

**BREYNIA PATENS**, Benth. Hooker, v. 329. Trimen, iv. 33.

A shrub with spreading branches. Leaves small, semi-coriaceous. The ♀ flower, when young, hangs vertically on a short peduncle which moves into an erect position before the fruit is mature. Below 4000 ft. (431, 3800 ft.; 797, 4000 ft.)

**POUZOLZIA BENNETTIANA**, Wight. Hooker, v. 585. Trimen, iv. 117.

A low shrub. Rootstock horizontal, stout and woody; stems semi-succulent and hairy in the younger parts. Leaves densely hirsute on both sides. This specimen is nearer to var. *quadrialata* from the Nilghiris than to the Ceylon var. *Gardneri*. Rare. (865, 5600 ft.)

**POUZOLZIA PARVIFOLIA**, Wight. Hooker, v. 587. Trimen, iv. 117.
Stems diffuse, slender, prostrate, pubescent or hirsute; leaves strigosely hairy on both surfaces. Above 6000 ft. (*Trimen.*)

**BURMANNIA DISTICHA**, Linn. Hooker, v. 664. Trimen, iv. 130.
Very rare on the patanas. (284, 5800 ft.)

*Ipsea speciosa*, Lindl. Hooker, v. 812. Trimen, iv. 171.
The "Daffodil orchid." Flowers during the N.E. monsoon. Locally abundant about 5600 ft. (363, 5800 ft.)

**PHAJUS WALLICHII**, Lindl. Hooker, v. 816. Trimen, iv. 172.
Rather common between 3000 and 7000 ft.; especially at the higher elevations. (*Trimen.*)

**SPIRANTHES AUSTRALIS**, Lindl. Hooker, vi. 102. Trimen, iv. 217.
Very abundant above 5000 ft. (280, 5800 ft.; 495, 7000 ft.)

*Habenaria acuminata*, Thw. Hooker, vi. 133. Trimen, iv. 227.
Abundant below 5000 ft. (367, 5800 ft.)

**H. VIRIDIFLORA**, R. Br. Hooker, vi. 150. Trimen, iv. 231.
(860, 3800 ft.)

**H. TORTA**, Hook. f. Hooker, vi. 159. Trimen, iv. 234.
Abundant above 4000 ft. (409, 3500 ft.; 369, 5800 ft.; 857, 7200 ft.)

**SATYRIUM NEPALENSE**, D. Don. Hooker, vi. 168. Trimen, iv. 237.
Very abundant above 4000 ft. (667, 5600 ft.; 291, 5800 ft.; 332, 6200 ft.)

**CURCULIGO ORCHIOIDES**, Gaertn. Hooker, vi. 279. Trimen, iv. 269.
A perennial herb. Rootstock erect, fleshy, 8 inches or more long; roots stout, fleshy and tuberous; stem very short, covered by the fibrous remains of old leaves; leaves radical, linear or lanceolate, slightly hairy. Abundant between 3000 ft. and 6000 ft.; one of the earliest plants to appear after a patana-fire. (410, 3800 ft.; 825, 5600 ft.)

**DIANELLA ENSIFOLIA**, Redouté. Hooker, vi. 337. Trimen, iv. 288.
Perennial. Rootstock horizontal, stout and woody; roots long and fibrous; leaves erect and stiff. (400, 2300 ft.)

**COMMELINA NUDIFLORA**, Linn. Hooker, vi. 369. Trimen, iv. 300.
Annual. Common on rocks above 5000 ft. (300, 5800 ft.)

**ANEILEMA DIMORPHUM**, Dalz. Hooker, vi. 377. Trimen, iv. 307.
Perennial. Roots thick and fibrous. Nodes of the stem and leaf-sheaths purple. Common above 5000 ft. (296, 5800 ft.)

CYANOTIS PILOSA, Schultes f. Hooker, vi. 387. Trimen, iv. 314.

Perennial. Roots numerous, thick and tuberous. Common among the grasses above 5000 ft. (298, 5000 ft.)

C. VILLOSA, Schultes f. Hooker, vi. 387. Trimen, iv. 313.

Perennial (?). Leaves densely villous with long silky hair (397), or pilose beneath and glabrous above (672). (397, 2000 ft.; 672, 5600 ft.)

C. FASCICULATA, Schultes f. (sp. ?). Hooker, vi. 387. Trimen, iv. 314.

Annual. Leaves floccosely silky. (673, 5600 ft.)

JUNCUS PRISMATOCARPUS, R. Br. Hooker, vi. 395. Trimen, iv. 318.

Perennial. Common in wet places. (408, 3000 ft.; 54, 3800 ft.; 53, 5600 ft.)

APONOGETON CRISPUM, Thunb. Hooker, vi. 564. Trimen, iv. 372.

Leaves submerged or floating; usually red. Common in running water on the patanas, at 6000 ft.

[The following species of *Eriocaulon* were found in marshy places on the patanas at the elevations indicated.]

*Eriocaulon caulescens*, Hook. f. & Thoms. Hooker, vi. 572.

On Pedurutalagala. (77, 8000 ft.)

*E. ceylanicum*, Koern. (E. subcaulescens, Hk. f.) Hooker, vi. 573.

On Horton Plains. (70, 7200 ft.)

*E. atratum*, Koern. Hooker, vi. 574.

Common above 5000 ft.

[No. 60 has straw-coloured involucral scales; in 71 they are brown with black edges, while in the type they are "glossy black." These appear to be forms of *E. atratum*, Koern.] (71, 6000 ft.; 60, 7200 ft.; 63, 8000 ft.)

E. WIGHTIANUM, Mart. Hooker, vi. 576.

A large species, common above 5000 ft. (72, 5600 ft.)

E. BROWNIANUM, Mart. Hooker, vi. 576.

Common above 5000 ft. (73, 5600 ft.; 76, 7200 ft.)

E. TRUNCATUM, Ham. Hooker, vi. 578.

Very abundant above 5000 ft. (61, 5600 ft.; 65, 5800 ft.)

E. COLLINUM, Hook. f. Hooker, vi. 584.

A very common species. (58, 3500 ft.; 59, 5600 ft.)

KYLLINGA BREVIFOLIA, Rottb. Hooker, vi. 588.

Perennial. In dry situations at lower elevations the habit is dwarfed. Very abundant in both wet and dry places. (9, 2000 ft.; 8, 4000 ft.; 11, 5600 ft.)

PYCREUS GLOBOSUS, Reichb., var. β. NILAGIRICA. Hooker, vi. 591.
Perennial. Marshy places above 5000 ft. (13, 5600 ft.)

P. POLYSTACHYUS, Beauv. Hooker, vi. 592.
Perennial. Marshy places above 5000 ft. (15, 5600 ft.)

CYPERUS PILOSUS, Vahl. Hooker, vi. 609.
Annual. In marshy places above 5000 ft. (16, 5600 ft.)

C. ZOLLINGERI, Steud. Hooker, vi. 613.
Perennial. In wet and dry situations. (18, 3000 ft.; 19, 5600 ft.)

MARISCUS PANICEUS, Vahl. Hooker, vi. 620.
Perennial. In dry situations. The same species was found in the sand at sea-level at Elephant's Pass, in the Northern Province (No. 21). (52, 2200 ft.)

FIMBRISTYLIS PENTAPTERA, Kunth. Hooker, vi. 645.
Perennial. On Horton Plains. (26, 7200 ft.)

F. COMPLANATA, Link, var. KRAUSSIANA. Hooker, vi. 646.
Perennial. On Horton Plains. (24, 7200 ft.)

F. NIGROBRUNNEA, Thw. Hooker, vi. 648.
A tufted perennial. In wet and dry situations above 2000 ft. (34, 2500 ft.; 36, 4400 ft.; 32, 5600 ft.)

F. CYPEROIDES, R. Br., var. CINNAMOMETORUM, Clarke. Hooker, vi. 650.
Annual (?). (29, 4000 ft.; 27, 4400 ft.)

BULBOSTYLIS CAPILLARIS, Kunth, var. TRIFIDA. Hooker, vi. 652.
Annual. (39, 5600 ft.; 40, 7000 ft.)

LIPOCARPHA ARGENTEA, R. Br. Hooker, vi. 667.
Perennial. (2, 3800 ft.; 1, 5600 ft.)

RYNCHOSPORA WALLICHIANA, Kunth. Hooker, vi. 668.
Annual. Common in dry situations. (43, 3800 ft.)

R. GLAUCA, Vahl. Hooker, vi. 671.
Perennial. (6, 5800 ft.)

CAREX LINDLEYANA, Nees. Hooker, vi. 721.
Perennial. Rhizome horizontal, stout, covered with old leaf-bases. (46, 4400 ft.; 47, 5600 ft.; 49, 7000 ft.)

*C. spicigera*, Nees, var. *minor*. Hooker, vi. 722.
Perennial. Horton plains. (44, 7000 ft.)

The following species of Gramineæ are perennial on the patanas:

PASPALUM SCROBICULATUM, Linn. Hooker, vii. 10.
A dwarf form. (83, 4000 ft.)

P. SANGUINALE, Lam., var. CORYMBOSUM. Hooker, vii. 13.
(94, 4000 ft.)

PASPALUM LONGIFLORUM, Retz. Hooker, vii. 17.
(99, 2500 ft.; 84, 3800 ft.)

ISACHNE KUNTHIANA, Wight & Arn. Hooker, vii. 41.
(92, 4000 ft.; 93, 5800 ft.)

AXONOPUS SEMIALATUS, Hook. f. Hooker, vii. 64.
(97, 98, 4000 ft.)

ARUNDINELLA VILLOSA, Arn. Hooker, vii. 72.
(154, 2500 ft.; 160, 4000 ft.; 161, 5600 ft.; 157, 7000 ft.)

A. LAXIFLORA, Hook. f. Hooker, vii. 75.
(155, 2500 ft.; 89, 4000 ft.)

A. LEPTOCHLOA, Hook. f. (sp. ?). Hooker, vii. 76.
(95, 4000 ft.)

ZOYSIA PUNGENS, Willd. Hooker, vii. 99.
(189, 3800 ft.)

DIMERIA TRIMENI, Hook. f.
(173, 5800 ft.)

IMPERATA ARUNDINACEA, Cyrill. Hooker, vii. 106.
(82, 3800 ft.)

POLLINIA PHÆOTHRIX, Hack. Hooker, vii. 112.
(163, 5600 ft.; 179, 5800 ft.)

ISCHÆMUM CILIARE, Retz. Hooker, vii. 133.
(135, 5600 ft.; 167, 5800 ft.; 138, 6200 ft.)

I. LAXUM, R. Br. Hooker, vii. 136.
(139, 4000 ft.)

POGONATHERUM SACCHAROIDEUM, Beauv. Hooker, vii. 141.
(133, 3500 ft.)

APOCOPIS WIGHTII, Nees, var. ZEYLANICUS (?). Hooker, vii. 142.
(126, 127, 4000 ft.)

ANDROPOGON SQUARROSUS, Linn. f. Hooker, vii. 186.
(121, 4000 ft.)

A. ZEYLANICUS, Nees. Hooker, vii. 192.
(116, 4000 ft.; 119, 5600 ft.; 117, 5800 ft.)

A. MONTICOLA, Schult. Hooker, vii. 192.
(178, 4000 ft.)

*A. polyptychus*, Steud. Hooker, vii. 198.
(112, 8000 ft.)

A. NARDUS, Linn. Hooker, vii. 205.
(110, 5600 ft.)

A. LIVIDUS, Thw. Hooker, vii. 209.
(111, 5800 ft.)

ANTHISTIRIA IMBERBIS, Retz. Hooker, vii. 211.
(176, 4000 ft. (?).)

ANTHISTIRIA TREMULA, Nees. Hooker, vii. 214.
(105, 3500 ft.; 106, 4000 ft.; 107, 5600 ft.)

A. TRIMENI, Hook. f.
(117, 3500 ft.)

*Garnotia tectorum*, Hook. f. Hooker, vii. 242.
(144, 5600 ft.; 6200 ft.)

CŒLACHNE PULCHELLA, R. Br., var. PERPUSILLA, Thw. Hooker, vii. 271.
(78, 7000 ft.)

TRIPOGON BROMOIDES, Roth. Hooker, vii. 287.
(90, 7000 ft.)

ERAGROSTIS STENOPHYLLA, Hochst. Hooker, vii. 318.
(86, 4000 ft.)

E. SECUNDA, Nees. Hooker, vii. 326.
(85, 88, 4000 ft.)

GLEICHENIA DICHOTOMA, Willd. Baker, 15.

Rhizome superficial; pinnæ glabrous, coriaceous, with recurved margin. Common below 4000 ft. (403, 2200 ft.; 780, 3800 ft.)

DAVALLIA TENUIFOLIA, Swartz. Baker, 102.

Rhizome superficial, densely fibrillose. Leaf-texture semi-coriaceous. (878, 3000 ft.; 621, 5600 ft.)

CHEILANTHES MYSURENSIS, Wall. Baker, 135.

Rhizome superficial; roots densely cæspitose; the more superficial ones covered with a brown wool. On boulders above 5000 ft. (622, 5600 ft.)

C. FARINOSA, Kaulf. Baker, 142.

The "Silver-fern." Rhizome superficial; roots densely tufted. Common on boulders above 5000 ft. (227, 5600 ft.)

PTERIS AQUILINA, Linn. Baker, 162.

Rhizome stout and very deep. Very abundant above 5000 ft.; and at lower elevations in sheltered localities, favourable for the accumulation of some depth of soil. One of the earliest plants to reappear after a patana-fire. In shady situations in the forest, the habit is much more luxurious than at the same elevations on the patanas. (809, 5600 ft.)

BLECHNUM ORIENTALE, Linn. Baker, 186.

Young leaves red-coloured*. Pinnæ narrow, glabrous, subcoriaceous. Common in sheltered localities below 4000 ft. (781, 3800 ft.)

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* *Vide* Ewart, 'Annals of Botany,' xi. p. 464.

**ASPLENIUM NORMALE**, D. Don. Baker, 197.

Rhizome short; roots very numerous and fibrous; petiole and rhachis black, glossy, and wiry. (407, 2200 ft.)

**A. FALCATUM**, Lam. Baker, 208.

Rhizome superficial and stout; roots numerous, fibrous; the more superficial ones covered with a dense brown pubescence; petiole and rhachis densely villous; pinnæ rigidly coriaceous, glabrous above, pubescent beneath. Common on rocks above 5000 ft. (268, 5800 ft.)

**NEPHRODIUM BEDDOMEI**, Baker. Baker, 267.

Rhizome slender and superficial. Thicker parts of the roots densely pubescent, with short brown hairs. On rocks above 5000 ft. (226, 5800 ft.)

**NEPHROLEPIS EXALTATA**, Schott. Baker, 301.

Rhizome woody and superficial. (406, 2200 ft.)

**POLYPODIUM OBLIQUATUM**, Blume. Baker, 328.

Rhizome superficial; roots dense and wide-spreading. (618, 5600 ft.)

**P. REPANDULUM**, Mett. Baker, 328.

(890, 5600 ft.)

*P. Gardneri*, Mett. Baker, 352.

Rhizome superficial, covered by closely-set paleæ; leaves simple, thick, coriaceous, glabrous above, densely tomentose beneath, with strongly recurved margins. Common on rocks on the patanas at low elevations. (404, 2300 ft.)

**P. LINEARE**, Thunb. Baker, 354.

Rhizome superficial; leaves simple, glabrous, coriaceous with recurved margins. Common on rocks above 5000 ft. (228, 5800 ft.)

**P. TRIFIDUM**, D. Don. Baker, 363.

Rhizome superficial, densely clothed with light brown paleæ; the superficial roots pubescent with short brown hairs. Common on rocks above 5000 ft. (272, 5800 ft.)

**P. NIGRESCENS**, Blume. Baker, 364.

Rhizome superficial, densely clothed with brown paleæ; leaves subcoriaceous. (271, 5600 ft.)

**ANTROPHYUM PLANTAGINEUM**, Kaulf. Baker, 393.

Rhizome superficial; roots densely pubescent with short brown hairs; leaves simple. (620, 5600 ft.)

HEMIONITIS CORDATA, Roxb. Baker, 398.

Rhizome superficial; roots fibrous, the superficial ones densely villous with brown hairs; petiole wiry, dark, glossy, fibrillose below; leaf simple, glabrous, thick coriaceous, rugose above. On the Uva patanas. (405, 3500 ft.; 792, 4000 ft.)

BOTRYCHIUM VIRGINIANUM, Sw. Baker, 448.

At high elevations. (574, 7000 ft.)

EQUISETUM DEBILE, Linn. Baker, 5.

(281, 5800 ft.)

LYCOPODIUM CERNUUM, Linn. Baker, 23.

Very abundant at about 6000 ft. (229, 5600 ft.)

L. CAROLINIANUM, Linn. Baker, 28.

Common above 5000 ft.; in swampy places. (832, 6200 ft.; 585, 7200 ft.)

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The Flora of the Patanas, in so far as this list represents it, consists of 289 species of Phanerogams and Ferns. 142 species were found on the dry patanas below 4500 feet, and 195 species on the humus patanas above 4500 feet; 48 species being common to both, and found generally all over the patanas. About 50 per cent. of these belong to seven natural orders, among which they are distributed in the following proportions:—

1. Below 4500 feet.

| | | |
|---|---|---|
| Gramineæ ...... | 13·3 | per cent. |
| Leguminosæ .... | 10·0 | ,, |
| Compositæ .... | 8·4 | ,, |
| Rubiaceæ ...... | 7·0 | ,, |
| Cyperaceæ...... | 5·0 | ,, |
| Ferns and allies.. | 5·0 | ,, |
| Labiatæ ........ | 2·8 | ,, |

2. Above 4500 feet.

| | | |
|---|---|---|
| Compositæ .... | 12·3 | per cent. |
| Leguminosæ .... | 8·7 | ,, |
| Ferns and allies.. | 8·2 | ,, |
| Gramineæ...... | 7·2 | ,, |
| Cyperaceæ .... | 6·6 | ,, |
| Rubiaceæ ...... | 4·0 | ,, |
| Labiatæ........ | 4·0 | ,, |

The other natural orders are poorly represented.

In conclusion, I desire to express my thanks to the University Cambridge for a grant of £100 from the Worts Travelling Scholars' Fund, and to the Rev. Herbert Alston, M.A., who defrayed the further expenses of my visit to Ceylon; to Mr. J. C. Willis, M.A., Director of the Ceylon Botanic Gardens, under whose advice I attempted this investigation, and to whom I am indebted for much kind assistance; to Mr. W. Nock, Superintendent of the Hakgala Gardens, whose extensive knowledge of the up-country flora was of great assistance to me; to William de Alwis, Muhandirem, Draughtsman at the Peradeniya Herbarium, from whom I received much valuable and kind help in the care and identification of my plants; to Mr. A. F. Broun, Conservator of Forests, who kindly allowed me to consult him, and from whom I received both information and literature, which could not be readily obtained elsewhere; to Sir Joseph Hooker, who has kindly named my specimens of the grasses of the patanas; to Mr. C. B. Clarke, F.R.S., to whom I am indebted for the identification of the Cyperaceæ and for assistance with some other groups; to the staff of the Kew Herbarium, from whom I have received much kindly assistance; to Professor H. Marshall Ward, to whom I submitted the plan of this investigation, and from whom I have received many valuable suggestions; and to my friend Mr. I. H. Burkill, M.A., who has kindly advised me concerning several points that have arisen in the prosecution of this research since my return from Ceylon.

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The Botanical Laboratory,
Cambridge.

# On Variation in the Desmidieæ, and its Bearings on their Classification. By G. S. West, B.A., A.R.C.S., Scholar of St. John's College, Cambridge. (Communicated by W. West, F.L.S.)

[Read 4th May, 1899.]

(Plates **8–11**.)

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## I.—*Introduction.*

This family of minute plants, so remarkable for beauty and extraordinary variety of form, is characterized by the constancy of those features and combinations of features which specifically distinguish the different members of the group. These characters are found to be present in specimens of the same species obtained from divers parts of the world, and, although often in themselves slight, are as easily discernible to the practised eye of the observer as are the specific characters of higher plants. On the examination of a large number of specimens of one species from many widely separated localities, certain examples are sure to be found which exhibit some variation from the typical plant, and without a very careful study of the species it is difficult to determine whether this variation is merely of a transitory or accidental nature, the specimen being the direct offspring of some type-form, or whether it constitutes a true variety produced by a gradual evolution from the original type. The ordinary method of increase in this family of unicellular plants * is by the division of the mother-cell into two exactly similar daughter-cells, each constituted of one of the half-cells of the mother and of a newly developed half. The latter is sometimes markedly different from the parent half, but in cases where this difference is extreme the new halves of the next division generally conform to the original type, though more rarely this may not occur for several generations.

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* The Desmidieæ may be regarded as a family of unicellular plants evolved by retrogression from some sexually differentiated ancestors (*cfr.* West & G. S. West, 'Obs. on Conjugatæ,' Ann. Bot. vol. xii. March 1898). Some few of the genera are filamentous, but these embrace only a very small minority of the known species, and they, as a rule, easily dissociate into individual cells,

The great diversity of form and wonderfully varied character of these plants are to be associated with their confinement to small ponds or the quiet margins of lakes, &c., localities suitable for their existence in large numbers. In these restricted areas the unceasing effect of the struggle for existence will result in a gradually increasing diversity of form, and this is to be correlated with the immense numbers of individuals that are sometimes found in these situations.

There can be little doubt that at the present day the family of Conjugates which has attained a maximum state of specialization along one line, accompanied by degeneration along another, is the Desmidieæ; and also that the tendency has been in the direction of an increase in the complexity of morphological characters. May not this complexity of outline, which is so frequently accompanied by a complete defensive àrmour of spines and spinous processes, have been acquired as a means of resisting the attacks of many forms of aquatic animals? After the loss of the filamentous condition it became necessary that the solitary and unprotected individuals should acquire some means of defence. Presumably many forms developed spines and warts, or their outline became deeply incised, and, by a gradual process of natural selection or survival of the fittest, the present morphological complexity was in all probability for the most part brought about. These plants are devoured by many small aquatic animals—Amœbæ, Turbellaria, Oligochætes, Tardigrades, Crustacea, &c.; and it is a notable fact that those species occurring on wet rocks and other localities in which these enemies are either absent or very scanty, especially at high elevations, possess as a rule a comparatively simple outline. In such cases the plants are provided with a more or less abundant mucus, whereas

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especially prior to conjugation. Another fact testifying to this degeneration is the secondary assumption of the filamentous condition by certain species (e. g., *Micrasterias foliacea*) and the reversion in others (e. g., *Hyalotheca dissiliens*) to a type ef conjugation with sexually differentiated gametes.

those species occurring in deep bog-pools and the quiet margins of deep lakes, at which places these enemies abound, are possessed of a more complicated, and in many cases of a formidable, exterior.

As regards the conditions favourable to variation among the members of this group of plants, it may be said that the occurrence in large quantity of a particular species is most conducive to the production of deviations from the normal form. It may happen that in some localized spot an immense quantity of some particular species is occasionally produced by very rapid division, and in such a case some variation is almost always met with. Wallich was also of opinion that the prolific growth of large numbers of Desmids tended to produce variations, as in commenting upon the Desmidieæ of Bengal, he states * that "amongst the more common species a remarkable amount of *divergence* from the typical character is everywhere to be met with—a circumstance depending, no doubt, on those peculiarities of soil and climate which, in Lower Bengal, are so favourable to the exuberant and rapid development of the entire vegetable kingdom." Wide distribution and diversity of physical conditions may also tend to bring about the same result, but these factors exercise by no means so marked an effect on these lowly plants as on more highly organized plants and animals. Many Desmids have a very extensive and a few a world-wide distribution, yet such species appear to have no apparent constitutional variation adaptive either to the requirements of the different climates in which they exist, or to the varying altitudes at which they occur. This may be chiefly, or at least in part, owing to their aquatic mode of existence.

The most numerous variations are to be found amongst the commoner and more widely distributed species, those occurring in rarer forms being, as a rule, either extremely slight or very abnormal. The majority of these variations appear to affect only the superficial characters—the warts, spines, striolations, granules, scrobiculations, &c., on the external or internal surfaces of the cell-wall. Some of them, however, are more important modifications, being changes in the external form or symmetry of the plant; and yet others are variations in the structure and arrangement of the cell-contents.

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* G. C. Wallich, "Desm. of Lower Bengal," Ann. Mag. Nat. Hist. 1860.

That variation in a species has a tendency to be reproduced there can be no doubt, especially when the reproduction takes place, as in these plants, by simple cell-division; yet extreme modifications, which are obvious abnormalities * (Pl. **10.** fig. 6, and Pl. **11.** fig. 27), are never (or very rarely) repeated in succeeding generations and may be regarded merely as accidental occurrences in the history of the species. Again, it must not be supposed that the variability of some diagnostic wart or spine, or some other character, makes that character of no use as a specific distinction, for such a feature may be always present to a greater or less degree and hence distinctive, and even in those specimens in which it is absent it is often produced at its maximum on the completion of the development of the younger semicells of a succeeding generation. This fact is well illustrated by certain variations, which I have described in *Arthrodesmus convergens* (see p. 398), which show the lateral spines reappearing on the semicells of a later generation, the few previous generations having been destitute of such structures. It is also exhibited by some specimens of *Cosmarium Regnesii* from Puttenham Common, Surrey (Pl. **10.** figs. 16 & 17), these examples being selected from a gathering of a large quantity of the species preserved while in active growth.

It generally happens that the variation is identical on the two sides of a semicell, or even of a cell; this is Bilateral Symmetry of Variation. Thus in the symmetrical Desmidieæ (and most of them are perfectly symmetrical) the majority of the variations observed consist of "similar and simultaneous variation of repeated parts" †.

The symmetry and pattern exhibited by the Desmidieæ are probably more striking than those shown by any living vegetable organisms of more complex character. Although merely unicellular organisms, major and minor symmetries are observed to play a prominent part in the construction of exquisite patterns; and the question of the "significance of pattern" in these beautiful little plants is therefore one of deep interest. The complexity of outline so characteristic of the majority of Desmids has been stated to have been developed in all probability during the gradual evolution of the Desmid-forms from the original filamentous Conjugates with cylindrical cells, the loss of the filamentous condition necessitating the development of some other protective characters. The acquirement by the unicell of these protective characters—protective not only against the depredations of small aquatic animals, but also in part protective as anchors in time of floods—has resulted in the division into lobes and often into toothed lobules, sometimes accompanied by a flattening of the cell, and at other times by the development of processes of multiform character, or of spines, warts, or other protuberances. There is a Law of Symmetry recognizable in all living objects, a visible token of the law and order which everywhere accompany vital phenomena: and in the acquirement of these wonderfully varied features and useful characters by this specialized family of plants this Law of Symmetry has exercised its full influence, resulting in the production of the exquisite patterns that are often met with.

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* *Cfr.* W. Archer, "Notice of some cases of abnormal growth in the Desmidiaceæ," Dub. Nat. Hist. Soc. Proc. vol. iii. t. 1, ex part.; Journ. Micr. Soc. 1860, t. 7, ex part. Reinsch, Contrib. Alg. et Fung. t. 18. ff. 9–15. Jacobsen in Botanisk Tidsskrift, vol. viii. 1875, t. 8. ff. 30, 31. West in Journ. Bot. 1889, t. 291. f. 5. West & G. S. West in Journ. Roy. Micr. Soc. 1896, t. 4. ff. 55, 56; Ann. Bot. vol. xii. 1898, t. 4. ff. 39, 40. Nordstedt in Kongl. Sv. Vet.-Akad. Handl., Bd. xxii. no. 8, 1888, t. 7. ff. 8–11. Raciborski in Pamietnik. Akad. Umiej. w Krakow. Wydz. matem.-przyr. vol. x. 1884, t. 14. f. 3. Gutwinski in Rosprawy Akad. Umiej. Krakow. Wydz. mat.-przyr. ser. 2, tom. xxxiii. 1896, t. 7. f. 60. Schröder in Forschungsberichten a. d. Biol. Stat. zu Plön, Bd. vi. t. 2. f. 3; and many other examples which might be quoted.

† *Cfr.* Bateson, 'Study of Variation,' 1894, p. 569.

The presence of major and minor symmetries is most distinctly evident in some species of *Micrasterias*, in which it often happens that only the corresponding lateral lobules agree in the extent of their subdivision; cfr. *b*, *b'* in fig. 1 (p. 371). Another proof of this is found in the extraordinary variation sometimes met with in the corresponding lobules on each side of a semicell; cfr. *a*, *a'* in fig. 1.

In commenting on *Cosmarium pileigerum*, Lagerh., and some varieties of *C. pseudotaxichondrum*, Nordst.,* the late Rev. Francis Wolle somewhat hastily states † that "G. v. Lagerheim appears to give too much prominence to simple differentiations—mere vagaries of the same species." I have examined large numbers of examples of *Cosmarium pseudotaxichondrum* and allied species and varieties from many parts of the world, and can truly say that Prof. G. v. Lagerheim did not give "too much prominence to simple differentiations." Many of these differentiations are combinations of characters which are repeated in hundreds, and I may say in thousands, of individuals, and can therefore be rightly considered as constituting distinct varieties. Moreover, how is it that identical species of these minute forms of plant-life, which Wolle would have us believe so easily give rise to differentiations and vagaries, are found in such widely separated places as Madagascar and the United States, with precisely the same characters—the same markings, granule for granule? Such is the case with *Euastrum trigibberum* *. Now, if "permanent variation" (and I have attempted to show that these varieties *are* permanent) did occur so readily, then in a very few generations the character of the species would be totally changed; but the adducible evidence is quite against such a supposition. It must be admitted that in all probability a vast period of time † has

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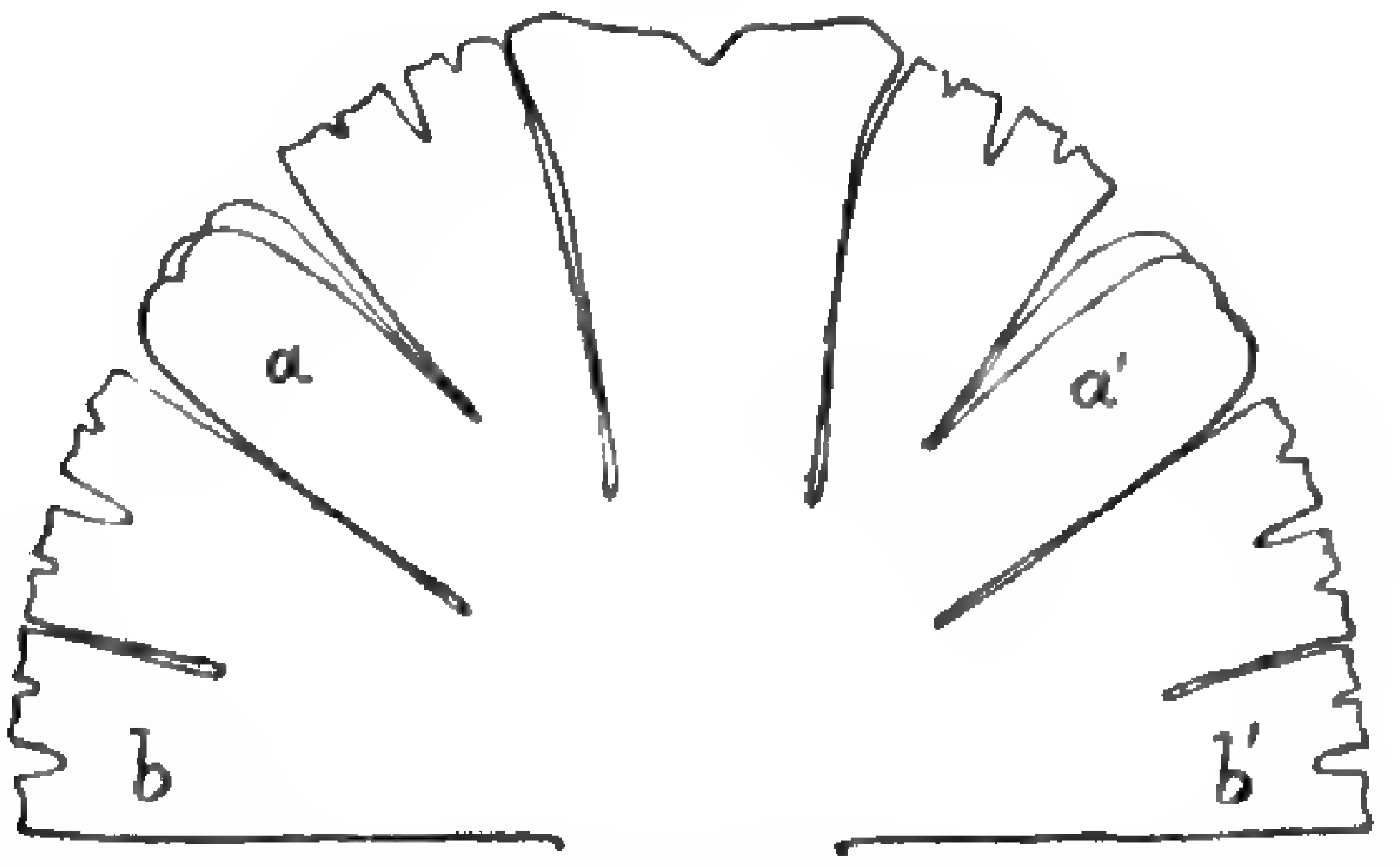
* *Vide* G. v. Lagerheim, "Bidrag till Amerikas Desmidie-flora," Öfvers. af K. Sv. Vet.-Akad. Förh. 1885, no. 7, p. 238.

† F. Wolle, Freshw. Alg. of the United States, 1887, p. 32.

Fig. I.



Semicell of *Micrasterias denticulata*, Bréb., from Wrynose, Lancashire. ×200.

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* West & G. S. West, "Freshw. Alg. of Madag.," Trans. Linn. Soc., Bot. ser. II. vol. v. p. 53, pl. vi. f. 22; "N. Amer. Desm.," *l. c.* pt. 5, p. 245, pl. xiv. f. 34.

† These lowly forms of plant-life, to quote a somewhat generalized statement by Wallace ('Darwinism,' p. 114), occupy a position in the vegetable kingdom similar to that occupied by earthworms in the animal kingdom, "filling places in nature which would be left vacant if only highly organized plants existed. There is, therefore, no motive power to destroy or seriously to modify them; and they have thus probably persisted, under slightly varying forms, through all geological time." The facts of distribution, although at present very imperfectly known, all tend to confirm the persistent nature of these plants.

elapsed since the original distribution of *Euastrum trigibberum* in Madagascar and the United States, yet this species has been perpetuated through this long period of time by two such far-distant assemblages, and the resultant present-day N. American form, far from being greatly differentiated from the Malagasy type, is identical with it. It might be argued that this result has been obtained by a parallelism of modification in the course of the evolution of these forms; but this is most unlikely, as proved by the occurrence of many species with such a distribution as the following:—*Micrasterias foliacea* in North and South America, India, Burmah, and Queensland; *Triploceras gracile* in North and South America, Europe, India, China, Australia, and New Zealand. I may also mention that the transference by natural means of living specimens of any Desmid from one of these countries to the other is an utter impossibility, desiccation, or in many cases even partial drying, being quickly followed by death, and submergence in sea-water is equally fatal *. Moreover, zygospores, which might possibly withstand the entailed vicissitudes if circumstances arose by which they could be transferred from one country to another (such as by the long flight of a wading-bird), are so rarely found that distribution by their means across an expanse of ocean is almost impossible. There is but one conclusion to be arrived at from a consideration of these facts, viz.: that such a species has been perpetuated by two isolated communities which were derived originally from one assemblage, and that the individuals of these communities have retained their original characters in an extraordinarily constant manner.

This constancy of character is not only found in certain rare species of restricted distribution, such as those just mentioned, but in many much commoner species. Take, for instance, *Docidium Baculum*, Bréb.; this plant has a world-wide distribution †, and yet a Malagasy specimen of the type-form could not be distinguished from an English specimen. From these facts one would conclude that the natural production of a *permanent variation* in a Desmid-species is a more difficult matter than at first imagined.

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* One Desmid has been described as inhabiting brackish water—*Cosmarium salinum*, Hansgirg in Oesterr. bot. Zeitschr. 1886, p. 335; *cfr.* also "Prodrom. Algenfl. Böhm.," Archiv der naturwissenschaft. Landesdurchf. von Böhmen, 1888, Bd. vi, no. 6, p. 194, cum f. 115.

† *Docidium Baculum*, Bréb., is found throughout the greater part of Europe and N. America, also S. America, Northern India, Burmah, Madagascar, and Australia.

Notwithstanding the interesting nature of this subject, only two short papers have appeared treating directly upon the variability of the Desmidieæ. The first paper is by W. Schmidle *, in which, after a consideration of the variability of the granules ornamenting *Cosmarium punctatum*, Bréb., and its allies, he formulates the following statements:—"(1) Die Chlorophyllstruktur ist konstant bei einer Species dieselbe. (2) Die Gestalt der Zelle variirt innerhalb enger Grenzen. (3) Die Scheitelansicht zeigt konstant dasselbe Aussehen. (4) Die Granulation ist relativ sehr variabel. Doch ist eine gewisse Gesetzmässigkeit in der Anordnung der Punkte immer vorhanden, so jedoch, dass dadurch noch sehr heterogene Stellungen möglich sind."

The second paper is by Borge †, and in it he remarks upon the variability of *Closterium moniliferum*, Ehrenb., *Cosmarium* sp. (= *C. Meneghinii* var. ?), and *C. Botrytis*, Menegh.: he also mentions cases of variability figured by De Wildemann in *Euastrum crassum*, by Elfving in *Micrasterias* sp. (= *M pinnatifida* forms), by Johnson in *M. pinnatifida*, and by Borge in *Xanthidium cristatum*. Concerning Borge's paper I need say no more, but the four conclusions arrived at by Schmidle require a little consideration.

In the first place, with regard to the structure of the chlorophyll, it may be said that the recorded observations dealing with the variability of the cell-contents are so few as not to admit the formulation of any definite statement concerning it. A short account of all that is at present known about the subject is given at p. 399.

More evidence is forthcoming as to the variation in the form and symmetry of the cell, all of which tends to show that there is a variability of outline for each species within certain limits, these limits being very narrow and almost inappreciable in some but very wide in others. Schmidle's third statement with regard to the "Scheitelansicht" really comes under the variation in the form of the cell, and although in the majority of species the vertical view is more constant in outline than the front view, yet there are some (e. g. *Cosmarium biretum*, Bréb.) in which it is very variable.

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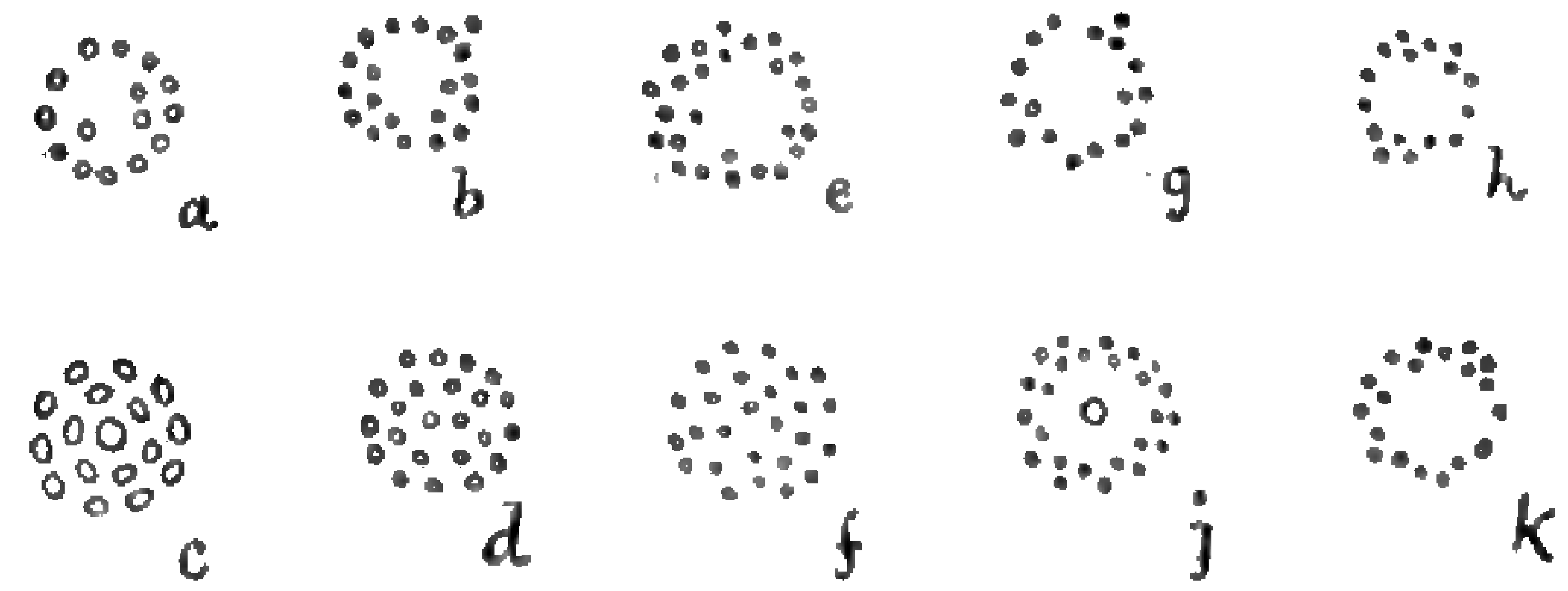
* W. Schmidle, "Ueber die individuelle Variabilität einer Cosmarienspecies," Hedwigia, 1893, Heft 3, pp. 109–115.

† O. Borge, "Ueber die Variabilität der Desmidiaceen," Öfvers. af K. Sv. Vet.-Akad. Förh. 1896, no. 4, pp. 289–294.

With regard to the ornamentation embellishing the exterior of the cell-membrane, much more detailed observation is required before any precise statement can be made concerning its variation. In some species the variation is in the arrangement of the warts, granules, scrobiculations, spines, &c., with which they are adorned; and in these cases there may be a considerable range of variation, which nevertheless does not, except under rare circumstances, transgress those laws which regulate the disposition of the adornments on any particular species under consideration. A very good example of this is seen in *Cosmarium orthostichum*, Lund.*, in which the large granules ornamenting the species are arranged on a fairly consistent plan and yet themselves exhibit a notable variation, especially in the centre of the semicells (*cfr.* Pl. **11.** figs. 1–4). Another illustration of this arrangement is afforded by *Staurastrum vestitum*, Ralfs, in which the emarginate warts on the dorsal surface are always disposed on the same plan, no matter how variable the inferior series (including the two furcate spines) may be. The central scrobiculations of *Xanthidium antilopæum*, Kuetz., although showing much variation with regard to their size and the details of their disposition, are also arranged approximately in the form of a ring (fig. 2, *a–k*).

Fig. 2.



Central scrobiculations of *Xanthidium antilopæum*, Kuetz. × 520. *a–d*, from Thursley Common, Surrey; *e*, from Ballynahinch, W. Ireland; *f–k*, from Pilmoor, near Thirsk, N. Yorks.

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* P. M. Lundell, "Desm. Suec.," Act. Reg. Soc. Scient. Upsal. 1870, p. 24, t. 2. f. 9.

In other species the variation may be confined wholly, or partially, to the extent to which some particular character is developed or suppressed. This is illustrated by ***Arthrodesmus convergens***, Ehrenb., in which one type of variability is the multiform character of the simple lateral spines (*cfr.* fig. 4, p. 398).

A few further remarks have also been made by Schmidle * on variation in the genus *Cosmarium*, more particularly with regard to *C. striatum*, Boldt, under which he includes forms of seven species.

I may here appropriately recall a remark made by Wallich †, that "the law which it is assumed governs the limits of a species is *no law*, but only a conditional direction, holding good only so long as the surrounding conditions continue the same," or, as amended by Turner ‡, "so long as the conditions of environment remain the same through a *lengthened* period of time." It has been already stated that specimens obtained from localities in which the conditions of environment are very diverse exhibit no marked constitutional differences adaptive to their several requirements. This being so, it is difficult to imagine the possibility of a slight change in surrounding conditions seriously affecting the characters of a species, unless the changed conditions continue to exist for a long period of time; and, again, any serious alteration in the characters of a species is doubtless effected by several such changed conditions, each of which continues for an extended epoch. That the Desmidieæ have existed through a vast period of time in much the same forms as they exhibit at the present day is highly probable.

The five statements which follow represent the result of the direct observations on variation in this group of plants, and may, owing to our insufficient knowledge of the question, be subject to further alterations. The first statement is a modification of Schmidle's first proposition; the second includes his second and third; in the third I disagree somewhat with the conclusions set down in his fourth; and the fourth and fifth are additional.

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* W. Schmidle, "Aus der Chlorophyceen-Fl. der Torfstiche zu Virnheim," Flora, 1894, Heft 1, pp. 52–56.

† G. C. Wallich in letter to Archer; *cfr.* Trans. Dubl. Micr. Club, 1865.

‡ W. B. Turner, "Freshw. Alg. of E. India," Kongl. Sv. Vet.-Akad. Handl. Bd. xxv. no. 5, 1892, p. 6.

1. *The structure of the cell-contents is one of the most constant features exhibited by a species; but this fact can be of little classificatory value owing to the very large number of species which possess the same structure and arrangement of the chromatophores.*

2. *The outward form of the cell, as seen in front view, varies within certain limits, which are usually very small, but which may in exceptional cases be considerable. The form of the vertical view is, as a rule, a more constant feature than the form of the front view.*

3. *The ornamentation (scrobiculations, granulations, spinulations, &c.) of the cell-wall is relatively constant, being always arranged according to a definite law, which is only transgressed by variations in one or more of the individual component groups which constitute the pattern of arrangement.*

4. *The prolific growth and rapid division of immense numbers of Desmids have a tendency to produce variations from the typical forms.*

5. *Changes in the conditions of environment cannot affect the characters of a species unless they act for long periods of time.*

## II.—*Variations in Form and Symmetry.*

Considerable difficulties are encountered in the attempt to cultivate these plants under perfectly natural conditions, and all the variations described were found in a state of nature. The following is a selected account of a few of those that I have observed during a prolonged study of the Desmidieæ.

Under this heading are included variations in the arrangement and disposition of the markings adorning the cell-wall; and I would here urge the plea that all published figures of Desmids be made *strictly accurate in detail*, and not drawn approximately so. In recent years many very inaccurate drawings have been published, not only of previously described species, but also of new species and varieties *. Though it may seem presumptuous to state that the figure by which a person has illustrated one of his own species is not accurate, yet it is undoubtedly true that many of these figures can be seen at a glance to be erroneous, not merely in detail, but also in their proportions, such proportions as are represented being incompatible with the symmetry of the plant.

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* That this is not the only branch of microscopical science in which gross inaccuracy with regard to detail is prevalent is clearly seen from remarks made by C. F. Rousselet, "Second List of New Rotifers since 1889," Journ. Roy. Micr. Soc. 1897, p. 10, in which he states that some of the published "figures and descriptions are quite useless as aids to further identification." He also remarks that "it would be very desirable in the interest of science if

A careful scrutiny of any species of Desmid suffices to demonstrate in its external morphological characters the presence of an inherent Symmetry and Repetition of Parts, and if, by careful study, the nature of this Symmetry were thoroughly understood in each species described, many unfortunate misconceptions and much useless synonymy would be avoided.

1. PENIUM SPIROSTRIOLATUM, *Barker, in Quart. Journ. Micr. Sc.*, New Ser., vol. ix.p. 194.—This interesting species, which is widely distributed through Europe and N. America, and is also recorded from India, Burmah, and Siberia, was described by Barker (*l. c.*) in 1869 from specimens obtained in Ireland, and was first figured by Turner in 1885 ("Some New and Rare Desm.," Journ. Roy. Micr. Soc. ser. II. vol. v. t. 16, f. 26) from specimens obtained from Minnesota, U.S.A. In 1875 a plant was described by Jacobsen as *Closterium spiraliferum* ("Desm. Danm.," Botanisk Tidsskrift, Kjöbenhavn, p. 177, t. 7. f. 8) and in 1883 Schaarschmidt described *Penium Haynaldii* ("Magyr. Desm.," Magyar. Tudom. Akad. math. s. Természettud. Közlemények, vol. xviii. p. 277, t. 1. f. 20). These two plants are undoubtedly forms of this species. More recently, in 1893, Turner has given diagnoses and figures of three forms which he distinguishes as *P. spirostriolatum*, Barker, *P. Royanum*, W. B. Turn., and *P. scandinavicum*, W. B. Turn. (*cfr.* Kongl. Sv. Vet.-Akad. Handl. Bd. xxv. no. 5, pp. 165–6. t. 23, ff. 3–7). These are undoubtedly mere forms of one species (*P. spirostriolatum*, Barker), and are not very accurately described or figured. Figures of this species were also given by West in Journ. Roy. Micr. Soc. 1890, t. 6. f. 24, but these are not very accurate.

The following observations were made from a large series of

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students of the Rotifera would exercise more care and discretion, and avoid giving new names on the slightest pretext, when it is well known that in many cases the original figures and descriptions are not perfect or complete, and that most species are liable to considerable variation."

specimens obtained from many parts of the British Isles and the United States, and exhibit many points in the morphological structure of the plant that were previously unknown, as well as proving conclusively that the above-mentioned species are merely forms of one plant.

This rare species of *Penium* generally frequents the few Desmid-bearing places in the bogs of mountainous countries, and is remarkable among all other Desmids as possessing a considerable number of transverse sutures. Each transverse suture observed on the cell-wall of a Desmid represents a position at which cell-division has taken place, and as I have observed as many as sixteen distinct transverse sutures in one individual of this species (long. 242 μ, lat. 25 μ) from Oughtershaw Tarn, W. Yorks., distributed at intervals from end to end, it follows that this plant had undergone cell-division at sixteen different points along its length. This is noteworthy, as in the vast majority of Desmids cell-division can take place only at one point (the isthmus) situated in a median position between the two ends *.

There is a wide range of variation in the comparative length and breadth of this species as well as in outward form. One of the shortest specimens (long. 123 μ, lat. 24 μ) was only 5·1 times longer than broad, and one of the longest forms (long. 274 μ, lat. 23 μ) was 11·9 times longer than broad, being over twice as long as the former. Two specimens of the same breadth, 26 μ, had lengths of 179 μ and 224 μ respectively. This large range of variation in comparative length and breadth is owing to the inequality in the positions of the sutures, for if division were to take place at a suture near to one end of the cell, and the newly developed halves ultimately became of approximately the same proportions as the corresponding parent halves, then a long and a short individual would be produced. The irregularity in the position of the sutures also accounts for the marked variations in outward form, because if the newly developed half be not exactly equal in length to the correspondent parent half (and if division takes place at a suture near one end these halves are probably never exactly equal) that section of the cell-wall which previously enclosed a median portion of the cell no longer does so, and in this way, in the course of many divisions, a short cylindrical portion of the cell-wall, which once occupied a central position in the cell, may become shifted about, first towards one end and then towards the other. Thus the widest part of the cell may be at any point between the two ends.

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* In some species of *Closterium* there are two, or even three, transverse sutures, and cell-division can take place at three points along the cell. I have seen as many as 21 transverse lines at one of these points in a specimen of *Closterium striolatum* from West Ireland; yet, in this specimen, cell-division could take place at only two points distant about one third the length of the cell from each apex.

In some specimens the apices are considerably dilated, in others not at all, and all stages are met with intermediate between these extremes.

The striolation of the cell-wall is the most variable character of the species, the striolations being coarse, fine, or broken up into series of dots even in different individuals from the same gathering, thus exhibiting the main characters of the three forms described by Turner as *Penium spirostriolatum*, *P. scandinavicum*, and *P. Royanum.* The number seen at one time across the cell varies from about 8 to 13, and this variation may be seen on one individual, the striolations being more crowded at some parts of the cell-wall than at others. In one individual two striations were observed to be 2·3 μ apart, and the distance between one of these and the next one was 5·2 μ. They are generally arranged round the cell in a spiral manner from apex to apex, and may make about 1¼ turns in the whole length of the cell; but in the majority of specimens they are much straighter than this, and in some are longitudinal although not quite straight. They are not always continuous from end to end, but often run only part of the distance and then fade away or join with a neighbouring striolation. In many cases they are very irregular (Pl. **8.** figs. 2, 4, 6, 9, 12), and a reticulation is often present joining together several, or all of them. This reticulation may not be very marked (Pl. **8.** fig. 2), or it may be concentrated towards the middle of the cell (Pl. **8.** fig. 3). In many examples there is a marked reticulation at the end of the cell (Pl. **8.** fig. 8), and sometimes a reticulated zone is present just below the apex (Pl. **8.** fig. 10). Most specimens have a distinct convex apical cap which is strongly punctate, the punctulations being continuous with those between the striolations. All the specimens I have examined were punctate between the striolations, some strongly and others faintly; but I have seen no specimen without these punctulations, however minute they may have been. I have not been able to determine definitely whether the striolations are the thickest or the thinnest parts of the cell-wall, but there is every indication that they are internal thickenings. In the majority of instances the edges of the striolations are not smooth, but exhibit various degrees of roughness, and in some specimens under a particular focus a reticulation is perceived to exist between the punctulations apparently connecting the striolations together (Pl. **8**. fig. 11).

From these facts it is clearly evident that the three species separated by Turner, and based upon differences in the strength of striolations, are merely forms of one and the same plant. The striolations have been shown to vary considerably in number and strength in different individuals in the same gathering, even on different parts of the same individual, and upon these characters Turner based his separation of *Penium spirostriolatum* and *P. scandinavicum*. In some examples the striolations frequently become discontinuous, forming series of dots (*cfr.* Pl. **8**. figs. 3, 4, & 6); and as this character was utilized to separate *P. Royanum*, this species must also be regarded as a mere form of *P. spirostriolatum*.

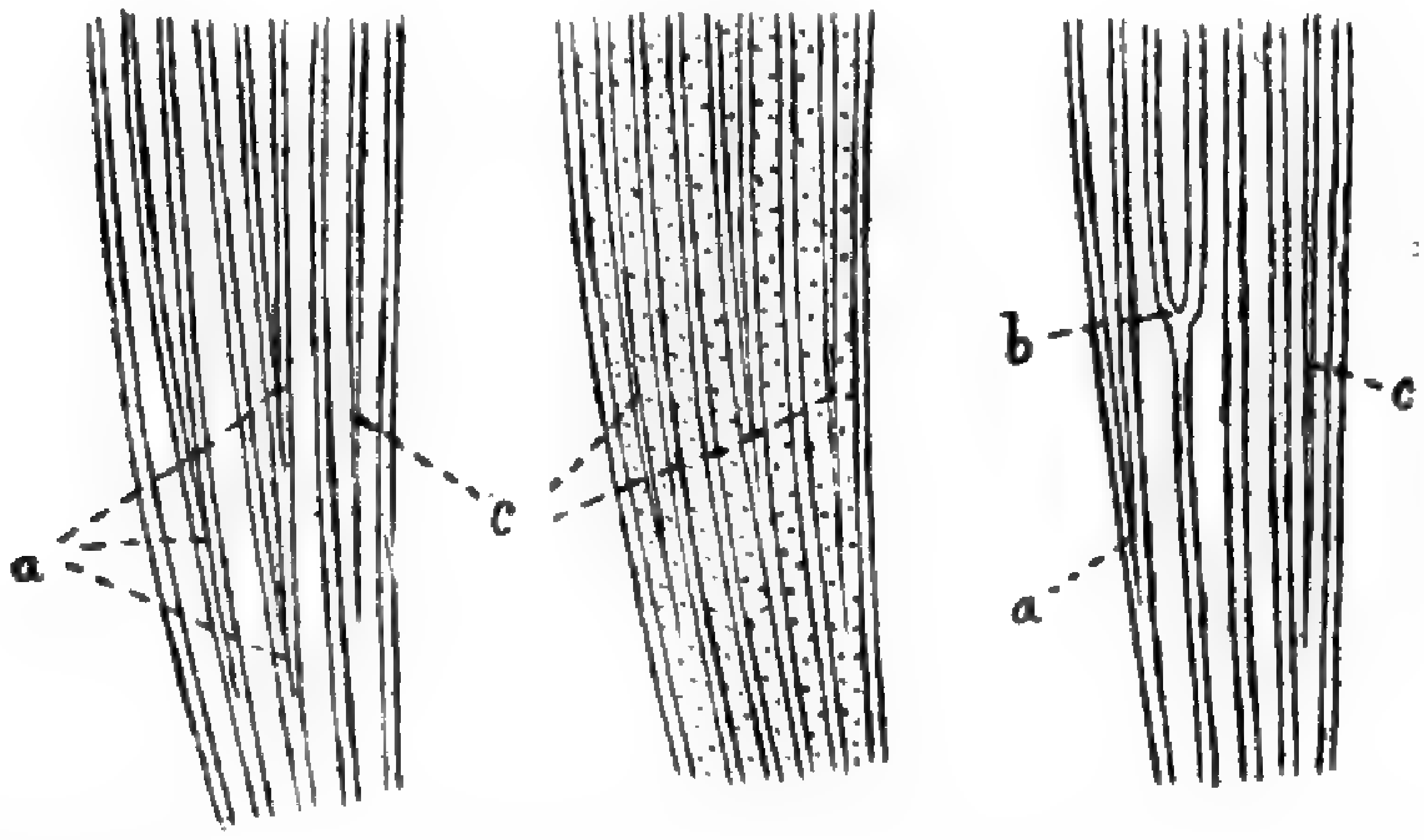
2. Closterium striolatum, *Ehrenb.*—The small amount of variation met with in specimens of this species is mainly found in the comparative breadth of the apices and the middle portion of the cell, and in the striolation of the cell-wall. The following table shows this variation in a series of specimens from three localities:—

| Specimens from | Breadth compared with length (average of 25 specimens). | Maximum breadth of apex compared with diameter of cell. | Minimum breadth of apex compared with diameter of cell. | Number of striolations in 20 μ. |
|---|---|---|---|---|
| Epping Forest, Essex. | 1 : 7·97 | 1 : 2·41 | 1 : 3·02 | 13 |
| Clapham, Yorks. ...... | 1 : 8·65 | 1 : 2·15 | 1 : 2·51 | 15 |
| Frensham, Surrey...... | 1 : 11·64 | 1 : 2·07 | 1 : 2·75 | 14 |

The specimens from the Surrey locality were not only longer than usual, but the apices were proportionately broader and more inflated than is generally the case in this species. The Yorkshire specimens had no trace of an inflation at the apices, and the cell-wall was almost colourless, this being a common feature of mountain specimens of *Closterium striolatum.* It might be inferred from the preceding table that the shortest and broadest forms possess the fewest striations (only 13 in 20 $\mu$), but that this is not so is shown by the fact that equally short specimens (breadth : length =1 : 1·75) from Cam Fell, W. Yorks., possessed 17 striations in 20 $\mu$. In a large series of specimens a considerable range of curvature is found, from the ordinary regularly curved examples to individuals which are almost straight (and generally short). Some of the longer forms have the central portion of the cell straight and apices considerably curved; these forms have been named var. *orthonotum,* Roy (in Journ. Bot. xxviii. 1890, p. 336).

Towards the attenuated ends of the cell the striolations become fewer in number, and this reduction may be caused in two ways: either by the gradual fading out of a few of the striolations, or by the fusion of some of them before they reach the apex (fig. 3). This fusion takes place very gradually (fig. 3, *a*), or, more rarely, suddenly (fig. 3, *b*). The cell-wall between the striolations is very minutely punctulate, the punctulations being marked in some instances, but almost inappreciable in others.

Fig. 3.



Part of the cell-wall of three specimens of *Closterium striolatum,* Ehrenb. From Frensham, Surrey. × 1280.

The average British specimens of this species have a gradual and regular curvature, and there is no trace of a ventral inflation; whereas the average N.-American specimens, besides being of larger dimensions, have a distinct small inflation on the ventral surface and proportionately narrower ends. The following dimensions are those of a specimen from Nova Scotia for comparison with those of the English specimens tabulated on p. 380:—Long. 380 μ; lat. 53 μ; lat. apic. 14 μ.

3. Closterium Kuetzingii, *Bréb., in Mém. Soc. Sci. Nat. Cherbourg*, vol. iv. 1856, p. 156, t. 2. f. 40.—This is a species which retains a comparatively constant outward form, but exhibits considerable variation in the extent of the ventral inflation of the semicells and in the striolations of the cell-wall.

The annexed table is a comparison of the measurements, &c., of several specimens taken from various parts of the country. The striations on those from Oxfordshire were not only fewer in number, but relatively stronger than those present on the majority of individuals from other localities, and for this reason the Oxfordshire examples might properly be relegated to var. *vittatum*, Nordst. ("Algol. Småsak.," Bot. Notiser, 1887, p. 163).

| Specimens from | Length. | Breadth. | Breadth : length. | Striolations in 10 μ. |
|---|---|---|---|---|
| Westmoreland ......... | 410 μ | 21·5 μ | 1 : 19·07 | 9 |
| W. Yorkshire ......... | 426 μ | 23 μ | 1 : 18·5 | 7 |
| Oxfordshire ............ | 430 μ | 14 μ | 1 : 30·7 | 5 |
| N. Wales ............... | 434 μ | 17 μ | 1 : 25·5 | 11 |

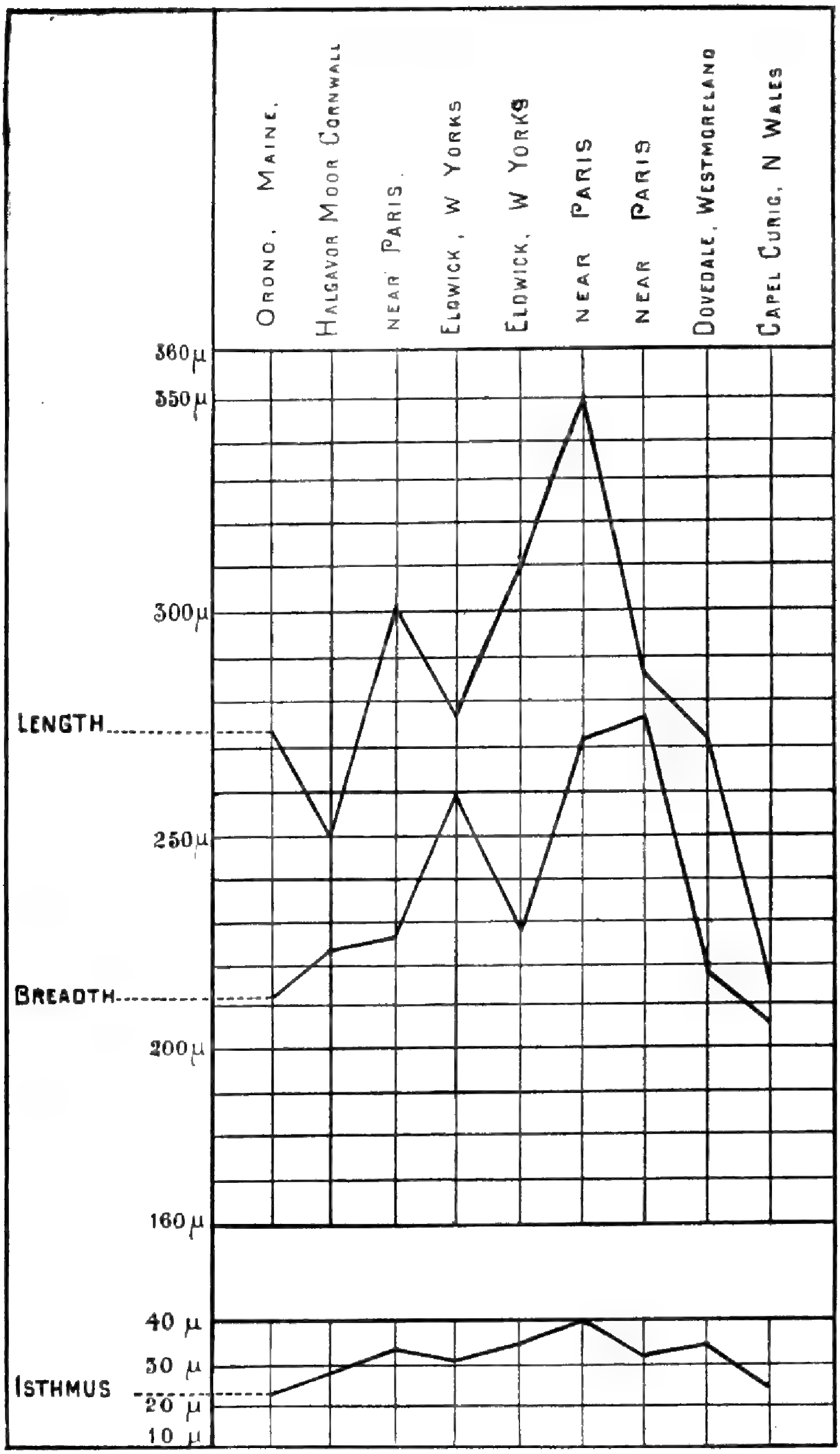
4. Euastrum Didelta, *Ralfs, in Ann. & Mag. Nat. Hist.* vol. xiv. 1844, p. 190, t. 7. f. 2.—This species, which, in temperate regions, is one of the most widely distributed of the genus, was first described as *Cosmarium Didelta* by Meneghini, "Synops. Desm.," Linnæa, 1840, p. 219, the name *Heterocarpella Didelta* having been given by Turpin (in Mém. du Mus. d'Hist. Nat. Paris, 1828, tom. xvi. p. 315, t. 13. f. 16) to a plant of doubtful identity. Many forms of the species have been described, among which the following may be mentioned:—var. *sinuatum*, F. Gay, "Essai Monogr. Conj.," Montpellier, 1884, p. 56, t. 1. f. 11;

var., Archer, in Quart. Journ. Micr. Sci. 1875, p. 414; var. *tatricum*, Raciborski, Pamietnik Wydz. Akad. Umiej. w Krakow. vol. x. p. 92, t. 13. f. 3; forma, Schmidle, in Oesterr. bot. Zeitschr. xlv. 1895, no. 7, p. 22, t. 16. f. 6, &c.; and I also give figures of some forms from widely separated localities (Pl. **8.** figs. 13–19) which will illustrate the considerable range of variation that is often met with. Some of these forms are more or less transitional between *Euastrum affine*, Ralfs, *E. ampullaceum*, Ralfs, *E. humerosum*, Ralfs, and *E. cuneatum*, Jenner.

5. MICRASTERIAS TRUNCATA, *Bréb., in Ralfs, Brit. Desm.* 1848, p. 75, t. 8. f. 4, t. 10. f. 5.—This species, which was first described as *Cosmarium truncatum* by Corda in 'Almanach de Carlsbad,' 1835, p. 180, t. 2. ff. 23–24, is probably the most generally distributed British species of the genus, and is often found up to considerable altitudes in mountain *Sphagnum*-bogs. It is equally widely distributed throughout continental Europe and North America, and for this reason it has frequently been made the subject of remarks by both English and foreign botanists. About twenty varieties have been described by different observers, many of which are not only connected with the typical plant by series of intermediate forms, but also connected one with another by similar intermediate series. Perhaps the most interesting series of variations are those described and figured by Jacobsen in 'Botanisk Tidsskrift,' vol. viii. 1875, p. 152, t. 8. ff. 2–8. These figures alone show that the species is subject to very considerable variation, and an examination of any gathering in which it is abundant will afford ample evidence that this variation is of frequent occurrence. Adding to this the rather remarkable fact that forms met with from different localities are rarely, if ever, identical in the extent and disposition of their lobulation, it behoves one to make an exceptionally careful study of the species before definitely assigning a varietal name to any individual specimen under consideration.

This is well illustrated by the figures I have given (Pl. **9.** figs. 9–16) of eight specimens, each from widely separated localities, and drawn under the same magnification. They show the wide range of variation in outward form, in the extent of the lateral lobulation, the considerable differences met with in the nature of the lateral incisions, the disparity in size, and the variations in the comparative length and breadth of the individuals. The smallest specimen is from Minnesota, U.S.A.: long. 102 $\mu$, lat. 98 $\mu$; the largest from Capel Curig, N. Wales: long. 138 $\mu$, lat. 129 $\mu$.

6. MICRASTERIAS DENTICULATA, *Bréb., in Mém. Soc. Acad. Sc. art. Falaise*, 1835, p. 54, t. 8.—This species, although not quite so generally abundant as *M. truncata*, is by no means uncommon, and has a world-wide distribution. Many variations have been described in the lobulation of the margin of the cell and in the form of the polar lobes; but I will confine my remarks to some other peculiarities frequently exhibited. In 1862, Archer described a species of this genus under the name of *M. Thomasiana* (Proc. Dubl. Nat. Hist. Soc. p. 72, t. 2. ff. 1–5; Micr. Journ. p. 259, t. 12), and, although a typical specimen of Archer's species possesses quite sufficient specific differences to separate it easily from *M. denticulata*, yet many intermediate forms are constantly met with. This fact induced Jacobsen (Botan. Tidsskrift, vol. viii. 1875, p. 187) to regard *M. Thomasiana* as forma *Thomasiana* of *M. denticulata*. Whether he was fully justified in so doing may long remain an open question, but there is no doubt that the main distinguishing feature of *M. Thomasiana* (the three large protuberances at the base of each semicell) is subject to very considerable variation. Figs. 2–5, Pl. 9, represent a few vertical views of intermediate forms, which show the extent to which the median protuberances may be developed or suppressed. The extremities of these protuberances may be rounded, papillate, or even bidentate (*cfr.* figs. 3, 5–8), and it not unfrequently happens that more than three are present on each side (fig. 5). The latter is, moreover, a form connecting *M. denticulata*, Bréb., with a species recently described by Bisset in Scott. Nat. 1893, p. 174, t. i. f. 2, as *M. verrucosa*. Individuals are often met with in which only two of these basal protuberances are present (figs. 6 & 7); and the smaller denticulations on the surface of the cell, which have a definite arrangement in the typical form of *M. Thomasiana*, are frequently quite irregular in their disposition (figs. 1, 7, & 8). The lobulation of the margin of the cell is described as being more acutely dentate in *M. Thomasiana* than in *M. denticulata*; but specimens of the latter species often possess an acutely dentate lobulation, without any of those more salient characters appertaining to *M. Thomasiana*.


Orono, Maine.
Halgavor Moor Cornwall
near Paris.
Eldwick, W Yorks
Eldwick, W Yorks
near Paris
near Paris
Dovedale, Westmoreland
Capel Curig, N Wales
360μ
350μ
300μ
Length
250μ
Breadth
200μ
160μ
40 μ
30 μ
Isthmus
20 μ
10 μ

The variations in the relative proportions of this species are illustrated by the preceding diagram (p. 385), which is constructed to show the independent variation in different directions of the length, breadth, and isthmus. The specimens are taken purposely from widely separated localities.

7. Xanthidium Smithii, *Arch.*, var. variabile, *Nordst.*, "*Algol. Småsak.*," *Bot. Notiser*, 1887, p. 159; *Kongl. Sv. Vet.-Akad. Handl.* Bd. xxii. no. 8, 1888, p. 44, t. 4. ff. 27–29.—I have seen this plant in many parts of the British Isles, sometimes in large quantity, and at other times very sparingly, but in all cases in *Sphagnum*-bogs. From the constant manner in which it retains its distinctive features, I am much inclined to regard it as a separate species apart from *X. Smithii*, Arch. The semicells are usually pyramidate, with broadly truncate apices, but many forms are met with intermediate between such a trapezoid and a rectangular semicell. There are three spines at each of the basal angles, these showing most distinctly at each of the poles of the vertical view. The latter are described and figured by Nordstedt (*l. c.*) as truncate, but I always find them to be rounded, and this has elsewhere been mentioned to be the case (*cfr.* Journ. Roy. Micr. Soc. 1896, p. 156). Three spines are generally present at each of the superior angles of the semicells, although two or even four are not uncommonly observed, and their disposition is often somewhat irregular (*cfr.* Pl. **8.** figs. 20–22, *b*, *b'* of vertical views). The central protuberance in the great majority of specimens is in the form of a simple papilla, but in a few I have observed it to be truncate and trituberculate (Pl. **8.** figs. 20, *a* & *b*).

8. Cosmarium læve, *Rabenh.*, *Flor. Europ. Algar.* iii. 1868, p. 161.—This species, first figured by Nordstedt in Öfvers. af K. Vet.-Akad. Förh. 1876, no. 6, t. 12. f. 4, is subject to considerable variation in the form of the semicells. Those of the typical form are of a somewhat semielliptical or subsemicircular outline, and very slightly retuse in the middle of the apex, the latter feature being characteristic of all forms of the species. A pure gathering obtained from the North of France consisted of very fine, large forms, mostly typical in outline (Pl. **10.** figs. 1 & 2), but in some cases with a tendency of the semicells to become more rounded: long. 28–34 $\mu$; lat. 19–23 $\mu$; lat. isthm. 5–5·8 $\mu$.

In another almost pure gathering of this species from Hanka Deela, Somaliland, the specimens were smaller (long. 19·5–28 μ; lat. 11·5–17 μ; lat. isthm. 3–5 μ), more elongate and somewhat angular, many of them approaching the var. *septentrionale*, Wille ("Ferskv. Alg. fra Nov. Seml.," Öfvers. af K. Vet.-Akad. Förh. 1879, no. 5, p. 43, t. 12. f. 34). This variety has been considered by some authors to be more nearly related to *Cosmarium Meneghinii*, Bréb. (in Ralfs, Brit. Desm. p. 96, t. xv. f. 6) than to *C. læve*, Rabenh.; but I think the range of variation exhibited by the specimens from Somaliland proves this supposition to be erroneous, all intermediate stages between typical *C. læve* and the var. *septentrionale* being met with in this one gathering.

*C. læve* var. *septentrionale* is very frequent in this country, and is itself subject to a certain amount of variation, especially with regard to the angularity of the semicells and the character of the superior lateral margins, the latter often exhibiting a marked undulation. I figure several such specimens: one from Bowness, Westmoreland, long. 25·5 μ, lat. 16 μ, lat. isthm. 4·8 μ, crass. 9 μ (Pl. **10.** fig. 8); one from near Giggleswick, W. Yorks., long. 24 μ, lat. 15 μ, lat. isthm. 5·2 μ (Pl. **10.** fig. 7); and one from Epping Forest, Essex, long. 24 μ, lat. 15·5 μ, lat. isthm. 5·5 μ (Pl. **10.** fig. 9).

The cell-membrane of the typical form is delicately scrobiculate, but that of the var. *septentrionale* is generally smooth.

9. Cosmarium Regnesii, *Reinsch*, "*Algenfl. von Frank.*," *Abhandl. Naturhistor. Gesellsch. Nürnberg*, Bd. iii. 1866, p. 112, t. 7. f. 8.—This minute species is not unfrequent in many of the mountain localities rich in Desmids, and any account of its various forms must necessarily be of particular interest.

In a gathering from *Sphagnum* and *Utricularia minor* on Puttenham Common, Surrey, an immense number of individuals were obtained in active division. The specimens were typical in size (long. 6–10 μ; lat. 6·2–9·5 μ; lat. isthm. 3–4·7 μ; crass. 5 μ) and many of them typical in outline; *i. e.*, the semicells were transversely oblong, with slightly retuse lateral margins, with the inferior and superior angles mucronulate, and with two small mucros, one on each side of a retuse middle portion of the apex (Pl. **10.** figs. 10, 12, 13, 15, 16). Some of the specimens, however, had the inferior angles of the semicells slightly emarginate, this resulting in a conspicuous alteration in the form of the sinus (Pl. **10.** figs. 11, 14, 17). Many stages were observed in the division of the cells, and it often happened that a second division of the cells commenced before the first was completed. This sometimes continued until several immature cells intervened between the original adult semicells (Pl. **10.** figs. 14, 15). A precise parallel to this is seen in *Staurastrum brachiatum*, Ralfs (*cfr.* West & G. S. West in Journ. Roy. Micr. Soc. 1896, p. 159, t. 4. ff. 55–56). In some cases division had taken place in one of these undeveloped cells which had previously become free, and on the completion of this division the newly-formed semicells were typical, showing that if a characteristic feature of a species be absent from any individual, it may be produced at its maximum in the semicells of a succeeding generation (Pl. **10.** figs. 16, 17).

In a gathering of an immense quantity of this species from Riccall Common, E. Yorks., the specimens were all of a rather large size (long. 10–12·5 μ; lat. 8·6–10·5 μ; lat. isthm. 3·6–4·5 μ; crass. 5 μ), and the superior angles were in many cases emarginate (Pl. **10.** figs. 18, 19).

From Pilmoor, N. Yorkshire, two forms were seen: one small form with much rounded semicells (long. 6·6 μ; lat. 6·6–7·4 μ; lat. isthm. 3·7 μ; crass. 3·9 μ), which might be regarded as var. *tritum*, West & G. S. West in Trans. Linn. Soc., Bot. ser. II. vol. v. 1895, p. 59, t. 9. f. 24 (Pl. **10.** fig. 20); and another very large form with somewhat rectangular semicells and frequently with emarginate superior angles (long. 10·9–11·7 μ; lat. 10·1–10·9 μ; lat. isthm. 4·6–5·6 μ; crass. 5·4 μ). This is the plant described by A. W. Bennett as *Euastrum crenulatum*[*] in Journ. Roy. Micr. Soc. 1887, p. 17, t. 4. ff. 20–21.

Great variation is met with in the vertical view of this species, some examples appearing quite elliptical, others having slightly tumid lateral margins and rounded poles, and yet others possessing a prominent protuberance in the middle on each side and a distinct, though smaller, one on each side near the poles (*cfr.* Pl. **10.** figs. 11, 19, 20, 21, *b*). The extent to which these protuberances are developed varies greatly even in specimens from the same locality, and this has induced me to remark upon a very interesting point.

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[*] Bennett's figure of the side view of this plant is incorrect.

In 1894 Eichler & Gutwinski described a var. *polonicum* of *Cosmarium Novæ-Semliæ*, Wille (Rospr. Wydz. matem.-przyr. Akad. Umiej. Krakow. tom. xxviii. p. 170, t. 5. f. 27), and the year following Schmidle described a var. *montanum* of *C. Regnesii* (*cfr.* 'Hedwigia,' 1895, p. 74, t. 1. f. 9; Oesterr. Bot. Zeitschr. xlv. 1895, p. 389, t. 15. f. 11). About the same time a species was described as *C. Pseudoregnesii* (*cfr.* West & G. S. West, Trans. Linn. Soc., Bot. ser. ii. vol. v. p. 59, t. 6. ff. 42–43); and shortly afterwards these were shown to be identical forms, all referable to *C. Regnesii* or *C. Pseudoregnesii* (*cfr.* West & G. S. West in Journ. Bot. xxxiv. 1896, p. 336–7). Schmidle has since termed his form *C. montanum*; but I think that a consideration of the variations described above as occurring in *C. Regnesii* proves conclusively that his species cannot be separated from the latter except as a variety, and therefore all the above-mentioned forms will fall under *C. Regnesii*, Reinsch, and its var. *montanum*, Schmidle.

10. COSMARIUM BIRETUM, *Bréb., in Ralfs, Brit. Desm.* 1848, p. 102, t. 16. f. 5.—This Desmid is by no means frequent, and seems to have a preference for the marshes of low-lying districts, in which situations it is sometimes obtained in abundance.

In a gathering of an immense quantity of this species from Welsh Harp, Middlesex, many variations in form were observed. The typical form of the semicells may be described as subrectangular with the lateral margins slightly divergent, the basal and apical angles rounded, and the apex somewhat convex. The divergence of the lateral margins varies very much (*cfr.* Pl. **10.** figs. 22 & 26), and this causes the semicells of some forms to possess a much broader apex than those of others. The conformation of the apex is also markedly different in different individuals. In some it is straight or but slightly convex, and may be even retuse in the middle, whereas in others it is strikingly elevated, being very convex and often truncate in the median part (Pl. **10.** figs. 25, 26). These two conformations of the apex may, however, be found in the semicells of the same individual. There is a considerable range in the size and in the roundness of the angles of this type of *C. biretum*, distinguished by its single inflation on each side of the vertical view. This latter character varied, in specimens from the same gathering, from a scarcely appreciable swelling on each side to a protuberance of some magnitude (*cfr.* Pl. **10.** figs. 27, 28). In 1879 Wille described a var. *intermedium* of this species (" Ferskv. Alg. fra Nov. Seml.," Öfvers. af K. Vet.-Akad. Förh. 1879, no. 5, p. 35, t. 12. f. 15), and in 1888 Boldt described two forms—forma *grœnlandica* and forma *subconspersa* (" Desmid. från Grönl.," Bihang till K. Sv. Vet.-Akad. Handl. Bd. xiii. Afd. iii. no. 5, p. 25, t. 2. f. 26); but these forms do not possess any characters sufficiently definite for them to have received varietal names, as all three of them, and all intermediate stages, were abundant in the gathering from Welsh Harp, Middlesex. Thus it may be said that the semicells of typical *Cosmarium biretum* may possess any approximately subrectangular or polygonal contour, and in vertical view may possess anything between a well-marked protuberance in the middle on each side and a scarcely appreciable inflation.

A second type of this species, more rarely found, exhibits rather different characters. In 1875 Nordstedt described two forms (" Desm. Arct.," Öfvers. af K. Vet.-Akad. Förh. no. 6, p. 26, t. 7. ff. 18, 19) which he named forma *supernumeraria* and subsp. *trigibberum*. These are each characterized by the possession of three protuberances on each side in the vertical view, a central one and one close to each end. I always find this second type of *C. biretum*, although showing a considerable range of variation in outline, to be more rounded in general

| *Cosmarium biretum.* | Proportion of breadth to length (lat. : long.). Average of a number of specimens. | Measurements of largest form. | Measurements of smallest form. | Average thickness. |
|---|---|---|---|---|
| *First type*: with one inflation on each side of vertical view. | 1 : 1·13 | Long. 48 μ; lat. 51 μ; lat. isthm. 15 μ. | Long. 38 μ; lat. 35 μ; lat. isthm. 13 μ. | 23 μ. |
| *Second type* (var. *trigibberum*): with three inflations on each side of vertical view. | 1 : 1·04 | Long. 57·5 μ; lat. 54 μ; lat. isthm. 21 μ. | Long. 43 μ; lat. 38 μ; lat. isthm. 12 μ. | 32 μ. |

contour and rarely to possess semicells with divergent lateral margins. The three protuberances on each side of the vertical view may be slight and more or less of equal size, or the central one may be much larger than the other two, the latter varying in their relative proximity to the ends (Pl. **10**. figs. 32 *b*, 33, & 34).

From the table on p. 390 it is seen that although the first type is relatively a little longer than the second, the latter reaches the largest dimensions, especially with regard to thickness.

The granulation of these two types is precisely the same; in fact, I should be justified in saying that the granulation of this species is its most constant feature, being eminently characteristic of all its forms.

11. COSMARIUM ORTHOSTICHUM, *Lund.*, "*Desm. Suec.*," *Act. Soc. Scient. Upsal.* 1870, p. 24, t. 2. f. 9.—This species is characterized by the possession of large granules arranged in approximately vertical and horizontal series across the surface of the semicells. The vertical arrangement is generally more readily discernible than the horizontal, the latter being at times replaced by oblique series. In the centre of the semicells the granules exhibit a variation with regard to their relative size, and in certain individuals one or more of them may be duplicated. In the vertical view the granules may show a distinct arrangement in transverse lines, or a clear space may be evident in the centre. *Cfr.* Pl. **11**. figs. 1–4.

12. STAURASTRUM MUTICUM, *Bréb.*, *in Menegh.* "*Synops. Desm.*," *Linnæa*, 1840, p. 228.—In a gathering of a large quantity of this species from Roundhay Park, W. Yorks., the semicells were observed to vary considerably in outward form. In some examples they were perfectly elliptical, in others reniform, in others elliptico-semicircular, and in many cases distinct basal angles were present, causing an almost linear sinus. Specimens were noticed with one semicell triangular and the other quadrangular, but the presence of both a three-angled and a four-angled semicell on the same plant is a variation of very frequent occurrence in species of this genus.

13. STAURASTRUM BRACHIATUM, *Ralfs*, *Brit. Desm.* 1848, p. 131, t. 23. f. 9.—This species frequents the most suitable

portions of *Sphagnum*-bogs, in which situations it may sometimes be obtained in abundance. It is subject to considerable variation in the character of its smooth processes. In some forms they are long and gradually attenuate to the apex, which is bifurcate (Pl. **11**. figs. 5 & 12); in others there is a distinct constriction near the apices of the processes immediately below the bifurcation (Pl. **11**. figs. 10 & 11); and it often happens that the divisions of the furcate apices are much rounded, being in some cases almost totally reduced (Pl. **11**. figs. 6, 7, and 11). The latter forms are produced by rapid division of the cells. Some of these forms are proportionately broader than others. Long. c. proc. 27–36·5 μ; lat. c. proc. 27–48 μ.

I have examined a form with short, thick processes and widely furcate apices, from several localities, notably from Slieve Donard, Co. Down, Ireland, and from Cornwall, from which places pure gatherings of the form were obtained. The apices of the processes were bi- or trifurcate, both types being present in the processes of the same cell, or even of the same semicell, and the divisions of the apex were large and acute. Long. c. proc. 27–29 μ; lat. c. proc. 25–31 μ. The processes of one semicell more or less alternate with those of the other, the amount of twist of the two semicells varying very considerably in different specimens.

Some remarkable forms of this species from Ireland were noticed, in which a series of immature segments were present between the adult semicells (*cfr.* Journ. Roy. Micr. Soc. 1896, p. 159, t. 4. ff. 54–55). No species is known in which the zygospore exhibits so much variation as it does in *S. brachiatum*.

14. STAURASTRUM REINSCHII, *Roy, in Scott. Nat.* 1883, p. 39.—This plant was first mentioned by Reinsch as "*Staurastrum* sp." in his 'Contrib. ad Algol. et Fung.' vol. i. Lipsiæ, 1875, p. 86, t. 17. f. 5, and was shortly afterwards described by Roy, who found it from several localities in Scotland, as *S. Reinschii*. I find it frequently in this country, more particularly in upland *Sphagnum*-bogs, in which situations it often occurs in quantity. The form of the semicells varies considerably, some being almost fusiform, others elliptical, and yet others almost semicircular, this causing a corresponding variation in the sinus. There are from two to four small spines at each lateral angle, and several others along the lateral margins, definitely arranged in one or

two series, the latter being most obvious in slightly tilted specimens (*cfr.* Pl. **11.** figs. 17 *b*″ and 19 *b*′). Typically there is but one series of four spines, the two middle spines being the largest. In some cases, however, the median pair alone are present; and in other specimens there may be a second series of four smaller spines beneath the larger series. In vertical view, the lateral margins may be concave, straight, or slightly convex, all these differences being frequently met with in the same gathering. The spines present at the lateral angles may be irregularly disposed or may be arranged one above another in a vertical plane. It is a small species and retains a relatively constant size: long. sine spin. 21–25 μ; lat. sine spin. 19–26 μ; lat. isthm. 6·5–7·5 μ.

15. STAURASTRUM CRENULATUM, *Delp.*, *in Mem. R. Accad. Sci. Torino*, ser. ii. tom. xxviii. 1877, p. 68, t. 12. ff. 1–11. *Phycastrum crenulatum*, Naeg. Gatt. einz. Alg., Zürich, 1849, p. 129, t. 8. B.—Much variation was observed in a large gathering of this species from Roundhay Park, W. Yorks. Some specimens were considerably broader than long (including the processes), and these usually possessed the emarginate warts developed at their maximum; long. 22–23 μ; lat. c. proc. 27–33 μ. A series of forms were observed which exhibited a gradual shortening of the processes, and consequently a proportionate increase in the length of the cells: long. 23 μ; lat. c. proc. 21–24 μ. Those forms with very short processes were sometimes remarkable for the reduction of the emarginate warts on the apices of the semicells (*cfr.* Pl. **11.** figs. 21–27). Some examples possessed much in common with *S. margaritaceum*, Menegh., var. *ornatum*, Boldt (in Öfvers. af K. Vet.-Akad. Förh. 1885, no. 2, p. 116, t. 5. f. 27; since placed by Turner as a species—*S. ornatum*).

16. STAURASTRUM ACULEATUM, *Menegh.*, "*Synops. Desm.*," *Linnæa*, 1840, p. 226.—This plant, first described by Ehrenberg (Die Infus. als vollk. Organ., Leipzig, 1838, p. 142, t. 10. f. 12) as *Desmidium aculeatum*, is one of the most characteristic species of the genus. Yet it is one which has been frequently misunderstood, large numbers of forms having been figured under the name of *S. aculeatum* which belong to widely different species. Figs. 28–32, Pl. **11.** are accurate representations of both European and American forms. As indicated by its specific name, the spines are well developed and are always arranged

on a definite system, although this is not readily discernible at first sight. There are always three or four large spines at each angle of the semicell and a lateral series, strongly developed, extending from angle to angle, as well as a more dorsal series also extending from angle to angle, those in the middle being as a rule (though not always) emarginate. Occasionally a few of the spines of the lateral series are duplicated, and the produced angles of the semicells possess encircling ringlets of minute denticulations. Any specimen which does not possess the above-mentioned characters cannot possibly be a form of *Staurastrum aculeatum.*

In 1872 Nordstedt described a var. *ornatum* of this species ("Desm. Spetsb.," Öfvers. af K. Vet.-Akad. Förh. 1872, no. 6, p. 40, t. 7. f. 27), and since that time much confusion has arisen with regard to certain allied forms. There can be no question that Nordstedt's variety is an extreme form of *S. aculeatum* in which the lateral and dorsal series of spines have become more numerous and somewhat complicated; but the arrangement of these spines is precisely similar to that in the typical form (as can be seen in Nordstedt's fig. 27 *b*). A few years subsequently to this Wille described some forms from Nova Zembla ("Ferskv. Alg. fra Nov. Seml.," Öfvers. af K. Vet.-Akad. Förh. 1879, no. 5, pp. 54–55, t. 13. ff. 67–69) which he named *S. aculeatum*, Menegh., var. *ornatum* Nordst. forma *spinosissima*, and *S. aculeatum* var. *depauperatum*; these belong undoubtedly to the same series of forms as S. *sexcostatum* and *S. margaritaceum*. Boldt has described a "forma *simplex*" of var. *ornatum*, Nordst. ("Desm. Grönl.," Bih. till K. Sv. Vet.-Akad. Handl. Bd. xiii. Afd. iii. no. 5, p. 38, t. 2. f. 49), which is unquestionably a form of *S. sexcostatum* subsp. *productum*, West; and Boergesen has also failed to comprehend the characters of *S. aculeatum*, having described a subsp. *cosmospinosum* of this species (Botan. Tidsskrift, Bd. xvii. p. 147, t. 6. f. 8) which is without doubt referable to *S. rostellum*, Roy et Biss. The list of confusing mistakes does not stop here, however, for we find forms of still more widely separated species referred to *S. aculeatum*. One more instance will suffice: Schmidle has recently described ("Lappmarks Süssw.-alg.," Bih. till K. Sv. Vet.-Akad. Handl. 1898, Bd. xxiv. Afd. iii. no. 8, p. 55, t. 2. f. 44) a var. *bifidum* of *S. aculeatum* which certainly has no connection whatever with this species, but rather with *S. forficulatum*, Lund., and more particularly with the forms he himself describes in the same paper as *Staurastrum forficulatum* var. *longicorne* (*l. c.* t. ii. ff. 42–43); in fact, Schmidle's *S. aculeatum* var. *bifidum* is, in my opinion, much nearer *S. forficulatum*, Lund., than is his *S. forficulatum* var. *longicorne.*

The variations I have noticed in *S. aculeatum* are perhaps worth mentioning. The most typical examples were from Capel Curig, N. Wales, and from the United States, the former specimens possessing the most strongly developed spines (Pl. **11.** fig. 31). From Orono, Maine, many examples were met with which had the spines considerably reduced in length, but were otherwise typical, and from Thursley Common, Surrey, a somewhat smaller but fully developed form was abundant (Pl. **11.** fig. 30).

17. STAURASTRUM VESTITUM, *Ralfs, Brit. Desm.* p. 143, t. xxiii. f. 1.—Few species exhibit so much variation as this, and at the same time retain their distinctive features. I need hardly mention that the main diagnostic character of *S. vestitum* is the possession of a pair of furcate spines in the middle of the lateral margins of the vertical view. These spines are themselves subject to much variation, being sometimes simple aculei, at other times furcate to their base, and more rarely doubly furcate. The general plan of arrangement of the spines and emarginate warts on *S. vestitum* is precisely like that on *S. aculeatum.* The angles of *S. vestitum,* which possess three well-marked divergent spines at their apices, are more produced than those of *S. aculeatum,* and, as a rule, the two median spines of the dorsal series become converted into emarginate warts. Of the lateral series of spines, which are such a marked feature of *S. aculeatum,* either the two median spines only remain in *S. vestitum,* or they are much more prominent than the rest. These are the characteristic furcate spines mentioned above. The front view of a typical form of *S. vestitum* resembles very closely that of some forms of *S. aculeatum,* but in the majority of specimens of the former species the angles are produced into processes of various length. In some these processes are very long (lat. c. proc. 90 $\mu$), and in others they are very short (lat. c. proc. 46 $\mu$). In a gathering from Arderry Lough, W. Ireland, some forms were observed which in front view could hardly be distinguished from *S. anatinum,* Cooke & Wills: long. s. proc. 35 $\mu$, c. proc. 52 $\mu$; lat. c. proc. 90–98 $\mu$; lat. isthm. 13·5 $\mu$.

There are several distinct varieties of this species:—var. *denudatum*, Nordst. ("Desm. Brasil.," Vidensk. Medd. nat. Foren. Kjöbenhavn, 1869, p. 230, t. 4. f. 40), in which the dorsal series of emarginate warts are much reduced; var. *semivestitum*, West (Journ. Roy. Micr. Soc. 1892, p. 732, t. 9. f. 38), a small twisted form with only one of the furcate spines on each lateral margin; and var. *tortum*, West & G. S. West (Journ. Linn. Soc., Bot. vol. xxxiii. (1898) p. 317, t. 18. f. 16), a larger form with curved processes twisted on their axes.

Var. *ornata*, Istv. (in Notarisia, no. 5, 1887, p. 240), is described "semicellulis dorso mucronibus bidentatis ornatis," but this is a character of the typical form.

18. STAURASTRUM FURCIGERUM, *Bréb., in Menegh.* "*Synops. Desm.*," *Linnæa*, 1840, p. 226.—This species, first described by Brébisson as *Binatella furcigera* (in C. L. Chevalier, 'Des Microscopes et de leur Usage,' Paris, 1839, p. 272), belongs to that section of the genus *Staurastrum* characterized by the possession of a superior and an inferior whorl of processes. The typical form possesses three processes in each of the whorls, the superior processes being situated immediately above the inferior, and placed at an angle of about sixty degrees to them. It is often found in quantity in pools amongst *Myriophyllum*, *Sphagnum*, and *Utricularia*; and in examining a large number of specimens from Birkhouse Moor Tarn, Helvellyn, and Pilmoor, near Thirsk, I was sufficiently fortunate to find one example from each locality which differed strikingly from the typical form. The superior whorl of processes of one semicell was duplicated, two processes being situated immediately above each one of the lower whorl. In one example (Pl. **10**. fig. 35) the two semicells were equally developed, but in the other (Pl. **10**. fig. 36) the semicell with the duplicated processes was more robust than the normal one, and the processes themselves much shorter and differently toothed at their apices.

In 1843, Ehrenberg ("Verbreit. u. Einfluss. mikr. Leb. Süd. u. N. Amer.," Physik. Abh. Preuss. Ak. Wiss. Berlin, t. 4. f. 23) described *Desmidium eustephanum*; this was referred five years later by Ralfs (Brit. Desm. p. 215) to *Staurastrum* as *S. eustephanum*, and has since appeared under that name in several text-books (*cfr.* Archer in Pritch. Infus. edit. 3, 1852, p. 742, t. 2. f. 3; Wolle, Desm. U.S. 1884, p. 147, t. 48. ff. 9–10; Cooke, Brit. Desm. 1887, p. 177, t. 62. f. 2). It differs from *Staurastrum furcigerum*, Bréb., only in the duplicated superior whorl of processes, and, carefully considering this fact, Nordstedt ("Desm. från Bornholm," Vidensk. Medd. natur. Foren. Kjöbenhavn, 1888, p. 207) placed it under *S. furcigerum* as forma *eustephana*. That he was quite correct in so doing is at once evident from a consideration of the variation in the two specimens described above, in which one semicell represents *S. furcigerum* and the other *S. eustephanum*. It is quite certain, therefore, that *S. eustephanum*, Ralfs, must be regarded in the future as *S. furcigerum*, Bréb., forma *eustephana*, Nordst. I have examined gatherings in which the form *eustephana* alone was present, but it is as a rule intermingled with the typical plant.

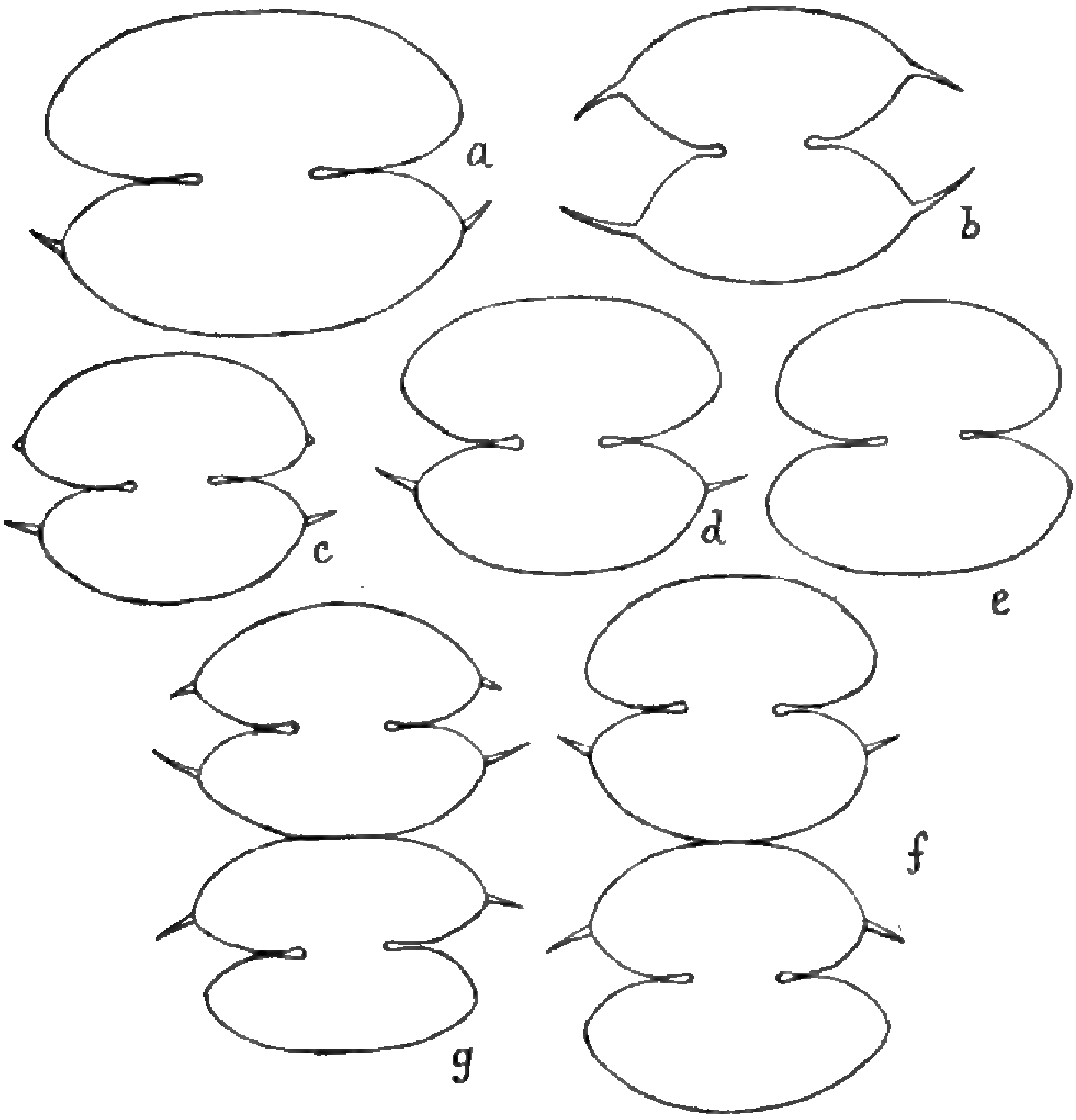
Another form of this species is forma *armigera*, Nordst. (*l. c.*). This was first described by Brébisson as *Staurastrum armigerum* in Mém. Soc. Sci. Nat. Cherbourg, vol. iv. 1856, p. 136, and subsequently redescribed by Reinsch as *S. pseudofurcigerum* in Abhandl. Naturhistor. Gesellsch. Nürnberg, 1866, Bd. iii. p. 169, t. 11. f. 2. It only differs from typical *S. furcigerum* in the duplication of the superior processes and in the slightly crenulate margins of all the processes, which have no small spines or granules.

The only other notable variation exhibited by this species appears to be the occasional development of a very robust form, similar to the stout semicell in fig. 36, Pl. **10**, but with only three superior processes. This form was described as *Staurastrum montanum* by Raciborski ("Nonn. Desm. Polon.," Pamietnik. Akad. Umiej. Krakow., Wydz. matem.-przyr. vol. x. 1884, p. 90, t. 12. f. 11), and more recently described as *S. furcigerum* var. *crassum*, Schröder (Forschungsberichten der Plöner Biol. Stat., Heft 5, 1897, p. 32, t. 3. f. 6). These two have been recently united, however, as *S. furcigerum* var. *montanum* (*cfr.* West & G. S. West in Journ. Bot. xxxvi. 1898, p. 335).

19. ARTHRODESMUS CONVERGENS, *Ehrenb.*, *Infus. als vollk. Organism.*, Leipzig, 1838, p. 152, t. 10. f. 18.—This species exhibits a wide range of variation in the degree of development of the lateral spines. This is at once noticed on comparison of a specimen similar to that figured from Capel Curig, N. Wales (fig. 4, *b*, p. 398), with one from Borrowdale, Lake District (fig. 4, *a*, p. 398). Examples are often found in which the spines

of one semicell are normal and those of the other reduced or absent, and by further division of such a plant a specimen may be produced in which the spines are entirely absent (fig. 4, *e*). On the division of this unarmed specimen, however the young semicells may develop typical spines, and it is interesting to note that a character which has been entirely lost is sometimes reproduced at its maximum development in a succeeding generation (fig. 4, *f*, *g*).

Fig 4.



*Arthrodesmus convergens*, Ehrenb. All × 520. *a*, from Borrowdale, Cumberland; *b*, from Capel Curig, N. Wales; *c–f*, from Pilmoor, near Thirsk, N. Yorks.; *g*, from Bowness, Westmoreland.

It is highly probable that there is some direct relationship between the unarmed forms of *Arthrodesmus convergens*, Ehrenb., and *Cosmarium scenedesmus*, Delp. (Mem. R. Accad. Sci. Torino, ser. II. tom. xxviii. 1876, p. 5, t. 7. ff. 28–34).

### III.—*Variations of Cell-contents.*

The arrangement of the chromatophores and the included pyrenoids is frequently a conspicuous feature of living Desmids, and it may be truly said that some particular disposition of these structures is one of the most constant features exhibited by several large series of these plants. Taking this into consideration, Lundell*, and also Boldt†, described several subgenera of Desmids founded mainly on the structure and disposition of the chromatophores. Subsequent observers elevated some of these subgenera to the rank of genera (e. g. *Pleurotæniopsis*‡ and *Pleurenterium*§); and the arrangement of the chromatophores thus assumed an important place in the study of this family of Algæ.

Moreover, the genus *Cosmaridium* was founded by F. Gay‖ on precisely those characters which were utilized by Lundell for *Pleurotæniopsis*, his subgenus of *Cosmarium*, viz.:—"Chromatophori e tæniis parietalibus, margine irregulariter lobata, pyren. nonnulos involventibus formati."

There are many strong reasons against the utilization of such easily destructible characters for generic distinctions, chief among which is the fact that living plants alone could be correctly referred to their true genera. Death so far renders the nature of the cell-contents undeterminable that were certain genera of this kind authoritatively recognized, specimens sent from abroad—and such specimens are generally dried or enclosed in preservative media—could not be satisfactorily referred to their proper systematic position; moreover, before these characters can be utilized positive proof of their importance has to be obtained, and how can this be done better than by a study of their variation?

A short paper by Lütkemüller¶ is the only contribution I can find dealing entirely with this subject, and in it he confines his attention to the number of pyrenoids in the genus *Cosmarium*, the chromatophores of *Penium minutum*, Cleve*, and of *Pleurotæniopsis*. In reference to the latter he advocates further enquiry into the structure of the chromatophores of those genera of Desmids which include species possessing parietal chlorophyll-plates. In a paper entitled "Observations on the Conjugatæ"† mention will be found of the occurrence of irregularities in the chromatophores of two species of *Cosmarium*—*C. ornatum* and *C. sphagnicolum*.

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* P. M. Lundell, "Desm. Suec.," Act. Soc. Scient. Upsal. 1870.

† R. Boldt, "Desm. från Grönland," Bih. till K. Sv. Vet.-Akad. Handl. Bd. xiii. Afd. iii. no. 5, 1888, p. 31.

‡ Utilized as a generic name by G. von Lagerheim in 'Botaniska Notiser,' 1887, p. 197.

§ Elevated to a genus by N. Wille in Engler and Prantl, 'Die Naturl. Pflanzenfam.' 1890, p. 11.

‖ F. Gay, "Note sur les Conj. du Midi de la France," Bull. Soc. Bot. France, tom. xxxi. 1884, p. 340.

¶ J. Lütkemüller, "Beobacht. über die Chlorophyllkörper einig. Desmid.," Oesterr. botan. Zeitschrift, xliii. 1893, no. 1, pp. 5-11, no. 2, pp. 41-44, tt. 2-3.

In the description of a species of *Closterium* it is customary to note the average number of pyrenoids in a semicell, and the character of the moving granules in the apical locellus or vacuole. No doubt these features are of some value as minor specific differences, and perhaps in many cases are quite as reliable as the more marked peculiarities of the species of other genera; yet I would point out that they are subject to considerable variation, and are, therefore, deserving of more careful study than that usually afforded them.

The following observations on *Closterium Venus*, Kuetz., were made on specimens from Baildon, W. Yorks. Out of 500 individuals examined 71 per cent. possessed two pyrenoids in each semicell, that is to say, two pyrenoids in each chromatophore. The next in frequency, although much scarcer (only 16 per cent.), were those possessing one pyrenoid in each chromatophore. This is illustrated by the following table:—

| Number of Pyrenoids. | Number of Specimens examined. |
|---|---|
| One in each semicell | 82 |
| One in one semicell, two in the other | 33 |
| Two in each semicell | 356 |
| Two in one semicell, three in the other | 24 |
| Three in each semicell | 5 |
| | 500 |

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* Lütkemüller records this species as *Docidium Baculum*, Bréb.; *cfr.* West & G. S. West in Journ. Bot. 1895, p. 65.

† 'Annals of Botany,' vol. xii. March 1898, no. 45.

The moving corpuscles in the apical locellus varied in number from three to nine, and were by no means constant in number at the two ends of the same individual. Out of sixty specimens observed, four possessed three moving corpuscles at the end, one possessed four, eleven possessed five, nine possessed six, twenty-nine possessed seven, three possessed eight, and three possessed nine. In some examples one large corpuscle was observed among an aggregation of small ones.

The apical locellus of the genus *Closterium* is nothing more nor less than a special terminal vacuole containing moving corpuscles, and although it varies considerably, it is nevertheless utilized in part as a generic distinction (compare the differences between the genera *Closterium* and *Roya*). It is a diagnostic feature of the genus *Closterium*, and is often the sole means of determining the correct position of small species of this genus which closely approach *Rhaphidium*, a genus of Palmellaceæ in which moving corpuscles are absent *.

If a gathering containing a number of living Desmids be kept growing for some time in a small glass vessel, it frequently happens that many of the specimens develop numbers of small moving granules in all parts of the cell. A gathering from Birkhouse Moor Tarn, Helvellyn, which contained a quantity of *Pleurotænium coronatum*, Rabenh., was kept growing in this manner for some time, and most of the specimens of this species became much vacuolated. Generally there were from four to six large vacuoles in each semicell, although some were noticed in which over twenty were present, and in the majority of these vacuoles a large number of moving corpuscles made their appearance. The latter were precisely similar to those present in the apical vacuoles of *Pleurotænium*; but were certainly different from the moving corpuscles present in the apical vacuoles of *Closterium*. I have noted the occurrence of the same phenomenon in many species of the genera *Penium*, *Cosmarium*, *Euastrum*, *Micrasterias*, and *Staurastrum*. It would seem, therefore, that these moving corpuscles can be developed in any vacuole in the plant if the latter be placed under suitable conditions †. They move freely in the fluid vacuole, and always collect towards its base as a small, incessantly moving mass.

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* *Cfr.* W. Archer in Quart. Journ. Micr. Science, ii. 1862, pp. 257–8; West & G. S. West in Journ. Roy. Micr. Soc. 1897, p. 501.

† Moving corpuscles of a nature similar to those found in Desmids have been noticed to arise in the vacuoles in the midst of the cell-contents of *Rhaphidium polymorphum* var. *mirabile*.

Thus, if the plant be rotated through 180°, the force of gravity immediately causes the corpuscles to descend through the fluid in the vacuole until they arrive at its new base. These corpuscles or granules are of a faint yellow colour, and appear brown in a thin stratum; but when present in immense numbers they sometimes give the plant a very dark (almost a black) appearance.

The following is a complete summary of all the records of variation in the cell-contents of Desmids :—

1. *Spirotænia obscura*, Ralfs. The structure and arrangement of the chromatophores described by Lütkemüller in Oesterr. botan. Zeitschr. xlv. 1895, pp. 2, 93, t. 1. ff. 1–6, 15–19.

2. *Penium 'minutum*, Cleve. Variability of chromatophores mentioned by Lütkemüller under the erroneous name of *Docidium Baculum*, Bréb. in Oesterr. botan. Zeitschr. xliii. 1893, p. 10, t. 2. ff. 9–15. (*Cfr.* remarks by West & G. S. West in Journ. Bot. vol. xxxiii. 1895, p. 65.)

3. *Cosmarium pyramidatum*, Bréb. Variability of pyrenoids described by Lütkemüller in Oesterr. botan. Zeitschr. xliii. 1893, p. 6, t. 2. ff. 1–8. (*Cfr.* Nordstedt in Index Desm. p. 215.)

4. *Cosmarium sphagnicolum*, West & G. S. West. Variations in chromatophores mentioned in Ann. Bot. vol. xii. 1898, p. 52, ff. 34–36.

5. *Cosmarium contractum*, Kirchn. Variability of pyrenoids recorded by Lütkemüller in Oesterr. botan. Zeitschr. xliii. 1893, p. 8, t. 3. ff. 16–18. Erroneously recorded by Lütkemüller as *C. pseudoprotuberans*, Kirchn. (*Cfr.* Nordstedt in Index Desm. p. 209.)

6. *Cosmarium ornatum*, Ralfs. Variability of pyrenoids mentioned by West & G. S. West in Ann. Bot. vol. xii. 1898, p. 52.

## IV.—*Variations in Conjugation.*

Few observations on the conjugation of Desmids have been recorded other than the mere mention of the occurrence of zygospores. I know of no instances of the occurrence of hybrids, and of few recorded instances of abnormal conjugation. The importance of this subject in its bearings on the classification of Desmids has not been sufficiently recognized, although it is a study which brings forward most interesting proofs of genetic relationship between many of these plants. It is also important in its bearings on the evolution of the Desmidieæ, a few observations on vagaries in the conjugation of *Hyalotheca dissiliens* having given a conclusive argument in favour of the view that the Desmidieæ constitute a degenerate family of Conjugates.

I append a full account of all that is known of the variation in the conjugation of these plants:—

1. *Closterium Pritchardianum*, Arch. Zygospore formed by the conjugation of three cells: West & G. S. West in Journ. Roy. Micr. Soc. 1897, p. 480, t. 6. f. 5.

2. *Cosmarium nitidulum*, De Not. Zygospore formed by the conjugation of four cells; erroneously recorded as a new species —*C. rectosporum*—by W. B. Turner in Kongl. Sv. Vet.-Akad. Handl. Bd. xxv. no. 5 (1893), p. 69, t. 10. f. 16 *e*.

3. *Cosmarium Regnesii*, Reinsch. Variability in form of zygospore: West & G. S. West in Journ. Roy. Micr. Soc. 1896, p. 155, t. 3. ff. 30–31.

4. *Staurastrum teliferum*, Ralfs. Zygospore formed by conjugation of three cells: West in Journ. Linn. Soc., Bot. vol. xxix. (1892) p. 175, t. 24. f. 5.

5. *Hyalotheca dissiliens*, Bréb. Abnormal conjugation mentioned by Joshua in Journ. Bot. vol. xx. 1882, p. 301; "cell. copul. monstr." described and figured by Boldt in Bihang till K. Sv. Vet.-Akad. Handl. Bd. xiii. Afd. iii. no. 5, 1888, p. 43, t. 2. f. 53; *cfr.* also West & G. S. West in Ann. Bot. vol. xii. 1898, p. 53, t. 4. f. 37.

## V.—*Some Interrelationships of the Desmidieæ deduced from a study of their Variation.*

The foregoing account of variations observed in a natural state enables us to adduce evidence which offers some clue to the relationships that exist between many different forms, and it realizes in part that which should be one of the main objects of classification, namely, how species may be brought into relationship one with another. The importance of this study cannot be overestimated, as it is the surest means of arriving at the most approximate limitations of what we call 'species,' and only after the attainment of a competent knowledge of the variability in the group can we form a conception of the evolution of Desmid-forms.

The question of the specific distinctness of many of these plants has been raised many times and by many people, and although it is one which will take a very long time to answer, yet a study of their variation will go far towards its solution.

The late Mr. William Archer stated[*] that "it is not proven that some other form, which in the present state of knowledge we are constrained to suppose a distinct species, may not in truth be only a phase of variation or of development, or an 'alternation of generation' of the actual species, whose extremes of variation, or whose life-history, are as yet unknown." Yet that eminent phycologist himself maintained that the inexperienced lumping together of species is as much to be deprecated as their over-multiplication. Klebs was certainly in error in grouping together many of the forms that he figured in his "Desmidiaceen Ostpreussens" [†], and concerning such treatment of these plants I will again quote a few remarks made by Archer [‡]:—"I would draw attention to a circumstance I am disposed to look upon as an almost unimpeachable argument as to their actual specific distinctness. I allude to the fact that, no matter how numerous or how few the fronds, the conjugating specimens always conjugate like form or species with like form or species—the abundant with their abundant neighbours of the same species, the rare seeking out the rare of the same species, and overlooking the possibly more numerous specimens of a perhaps closely-allied species. And it is marvellous, however few a certain species may be amongst the mass of others, by what attraction or force these little vegetable organisms, not endowed with a special locomotive power, are impelled to seek only their fellows when about to conjugate, avoiding other more abundant species, themselves even, perhaps, conjugating with each other at the time." But even allowing that the vast majority of these well-marked plants possess a specific distinctness, I would nevertheless join with Dr. Roy [§] in a protest against the "multiplication of so-called varieties" by certain inexperienced authors, who take no cognizance of the variability of species. As Dr. Roy remarks, "the time will no doubt come when species will be largely reduced, but it has not come yet; neither will it be accelerated by the indiscriminate manufacture of varieties, and still less by what is worse, varieties of varieties!"

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[*] W. Archer, "Descript. of new sp. of *Micrasterias*, with remarks on the distinctions between *M. rotata* and *M. denticulata*." Quart. Journ. Micr. Sci. New Ser., vol. ii. 1862, pp. 236–7.

[†] Schrift. d. physik.-oekonom. Gesellsch. zu Königsberg, vol. xxii. 1879, pp. 1–42, tt. 1–3.

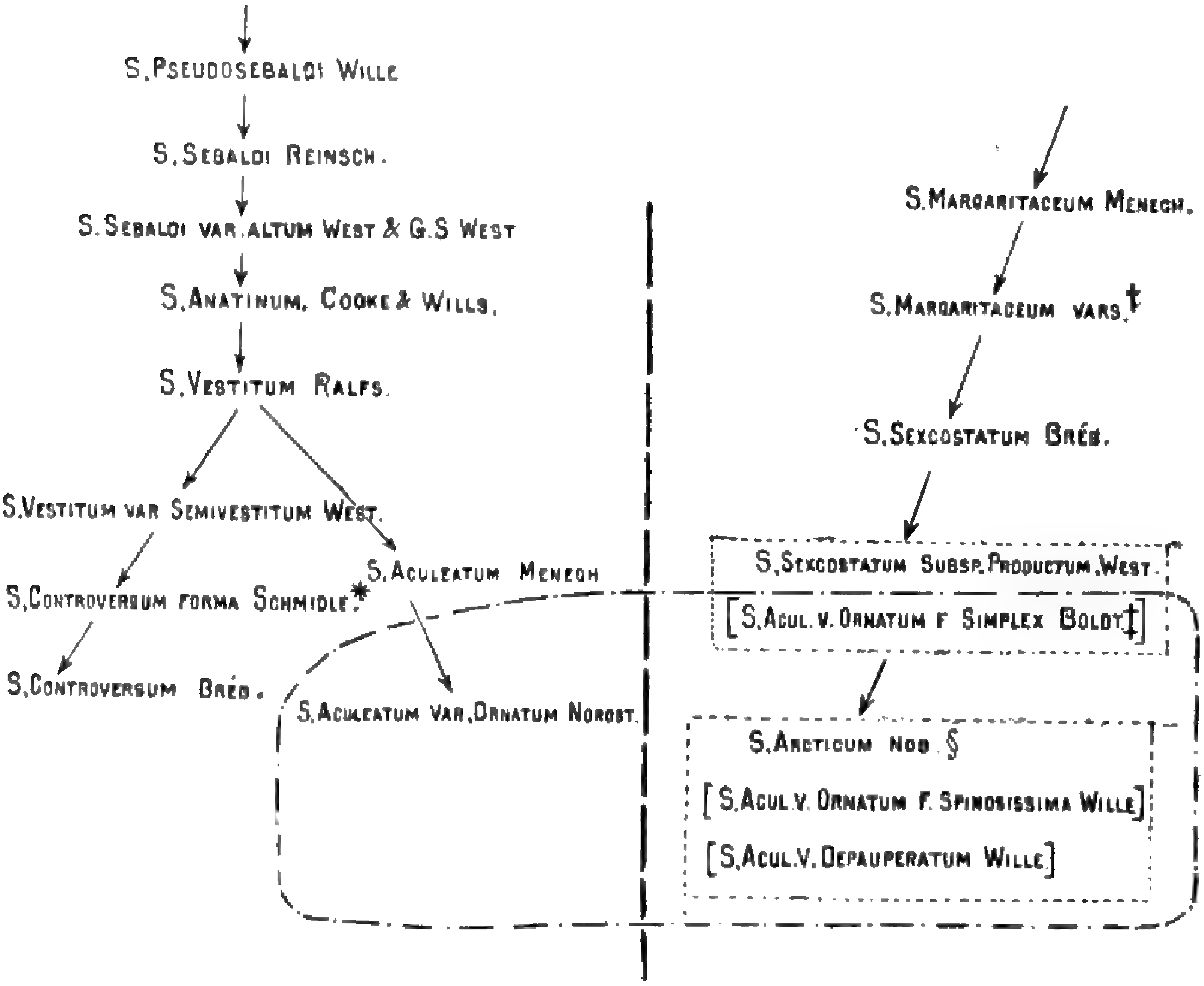
[‡] W. Archer, *l. c.* p. 237.

[§] J. Roy & J. P. Bisset, "On Scott. Desm.," Ann. Scott. Nat. Hist., April 1893.

Many of the so-called varieties that have been described for certain species are shown, by a study of the variation of the species, to be merely transitory forms founded upon accidental differences of a temporary character. (Cfr. *Cosmarium biretum* var. *intermedium*, *C. biretum* forma *grœnlandica*, and *C. biretum* forma *subconspersa*, p. 390, supra.) In a few cases, however, it can be shown by the same means that what was at one time regarded as a variety of a particular species, is in truth as much a distinct species (so far as we can comprehend the word 'species') as the plant to which it was formerly referred. In fact, the true affinity existing between many species of Desmids can be ascertained only by a careful study of their various forms, as exhibited in large numbers of specimens from divers districts; and in the following pages I have endeavoured to show clearly the particular relationship which exists between certain species about the position of which there has always been much discussion. It will also be seen that this study proves in some instances that species which have been imagined to possess a close relationship have only an apparent affinity, and have really arisen at some earlier or later stage in a particular line of descent, or else along totally different lines of evolutionary development.

I will first call attention to three species which, although very local, are widely distributed in Europe and N. America, viz.:—*Staurastrum vestitum*, Ralfs, *S. aculeatum*, Menegh., and *S. controversum*, Bréb. *S. vestitum* is a species which cannot readily be mistaken, and yet at the same time is one which exhibits a wide range of variation (*cfr.* page 395, *supra*). On the other hand, *S. aculeatum* is a species which has frequently been misunderstood, and, although closely related to *S. vestitum*, it exhibits a less range of variation than the latter. *S. controversum* appears to me to be more nearly related to *S. vestitum*, var. *semivestitum* than to *S. aculeatum*; and I think it highly probable that both *S. controversum* and *S. aculeatum* were originally evolved from *S. vestitum* along different lines, the former through such forms as that mentioned by Schmidle in 'Hedwigia,' 1895, t. i. f. 22. *S. vestitum* itself probably arose along a series terminating with *S. Pseudosebaldi*, Wille, *S. Sebaldi*, Reinsch, *S. Sebaldi* var. *altum*, West & G. S. West, and *S. anatinum*, Cooke & Wills, its earlier forms being long-armed like *S. anatinum*, and its later forms, which gave origin to *S. aculeatum*, being short-armed.

Another series of species which has been confused with that including *Staurastrum aculeatum* is the one which is constituted by *S. margaritaceum*, Menegh., *S. sexcostatum*, Bréb., and their derivatives. Certain forms derived from *S. sexcostatum* have most certainly acquired a resemblance to a few extreme forms of *S. aculeatum*; but this fact, in my opinion, is not owing to direct specific relationship, but rather to parallelism of modification along two totally different lines of evolution. The following table may better illustrate the idea that I intend to convey:—


S. Pseudosebaldi Wille
S. Sebaldi Reinsch.
S. Sebaldi var. altum West & G. S. West
S. Anatinum, Cooke & Wills.
S. Vestitum Ralfs.
S. Vestitum var Semivestitum West.
S. Aculeatum Menegh
S. Controversum forma Schmidle*
S. Controversum Bréb.
S. Aculeatum var. Ornatum Nordst.
S. Margaritaceum Menegh.
S. Margaritaceum vars.†
S. Sexcostatum Bréb.
S. Sexcostatum Subsp. Productum, West.
[S. Acul. v. Ornatum f Simplex Boldt‡]
S. Arcticum Nob. §
[S. Acul. v. Ornatum f. Spinosissima Wille]
[S. Acul. v. Depauperatum Wille]

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* W. Schmidle in 'Hedwigia,' 1895, t. i. f. 22.

† Cfr. *S. margaritaceum* var. figured by West in Journ. Roy. Micr. Soc. 1890, t. 6. f. 32.

‡ *S. aculeatum* var. *ornatum*, Nordst. f. *simplex*, Boldt, is unquestionably a form of *S. sexcostatum* subsp. *productum*, West, in Journ. Roy. Micr. Soc. 1892, p. 733, t. 9. f. 34.

§ S. ARCTICUM nob. includes *S. aculeatum* var. *ornatum*, Nordst., f. *spinosissima*, Wille (in Öfvers. af K. Vet.-Akad. Förh. 1879, no. 5, p. 54, t. 13. ff. 67–68), and probably *S. aculeatum* var. *depauperatum*, Wille (*l. c.* p. 55, t. 13. f. 69). The name '*spinosissimum*' could not be adopted, as there is a *S. spinosissimum*, W. B. Turner.

Another precisely similar case is brought forward in studying the forms allied to *Micrasterias oscitans*, Ralfs, and *M. pinnatifida*, Ralfs. In the first place, what is *Micrasterias oscitans*, Ralfs? It was described by Ralfs * in 1845 and figured by him † in 1848. Since that date no one has reported the occurrence of the typical form *exactly* as he figured it, although many forms have been described and figured intermediate between *M. oscitans* and a much more abundant species found some years later (1859), viz. *M. mucronata*, Rabenh. (first described as *Tetrachastrum mucronatum*, Dixon ‡). *M. mucronata* is a species frequently met with in upland *Sphagnum*-bogs, and the plant described as *M. oscitans* by Ralfs is unquestionably an extreme form of the same species, and, as it seems, a very rare one also. It is unfortunate that the form first found and described was the rare and aberrant one, as its specific name must be used, whereas the form commonly met with has to stand as a variety of it (viz. *M. oscitans*, Ralfs, var. *mucronata*, Wille §). There can be no doubt that both *M. oscitans*, Ralfs, and *M. laticeps*, Nordst. ‖, have arisen from that assemblage of forms known under the name of *M. oscitans* var. *mucronata*, but the origin of the latter is somewhat doubtful. After much consideration I should be inclined to think that the line of descent came through *M. depauperata*, Nordst. ¶, a decided relationship being evident between certain forms of *M. oscitans* var. *mucronata*, such as those described by Cooke **, and some forms of *M. depauperata* ††.

In temperate regions *Micrasterias pinnatifida* is a species of greater rarity than *M. oscitans* var. *mucronata*. It was first described by Kuetzing ‡‡ as *Euastrum pinnatifidum*, and many authors have followed Rabenhorst §§ in placing it as a variety of

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* Ralfs in Jenner, Fl. Tunbridge Wells, 1845, p. 198.

† Ralfs, Brit. Desm. t. 10. f. 2.

‡ Dixon in Trans. Dubl. Nat. Hist. Soc. 1859, p. 204, t. 1. ff. 5–8.

§ N. Wille, "Bidrag till Kundsk. om Norges Ferskv.-Alg.," Christiania Vid.-Selsk. Forhandl. 1880, no. 11, p. 21, t. 1. f. 3.

‖ Nordstedt in Vidensk. Medd. f. d. nat. Foren. Kjöbenhavn, 1869, p. 220, t. 2. f. 14.

¶ Nordstedt, *l. c.* p. 222, cum fig. xylogr.

** Cooke in 'Grevillea,' vol. ix. 1881, p. 89, t. 141. ff. 2 *b*, *c*.

†† *Cf.* the form in West & G. S. West, "Some N.-Amer. Desm.," Trans. Linn. Soc., Bot. ser. II. vol. v. pt. 5, p. 238, t. 14. f. 1.

‡‡ Kuetzing, Phycol. German. 1845, p. 134.

§§ Rabenhorst, Krypt. Flor. Sachs. 1863, p. 184; Flor. Europ. Algar. iii. p. 189.

*Micrasterias oscitans*, but for reasons best known to themselves. In studying the numerous forms of it and of allied species, one is struck by the continuous series they present,—a series ranging from *M. Crux-Melitensis*, Hass., through *M. Rabenhorstii*, Kirchn., *M. pinnatifida* var. *divisa*, West, *M. pinnatifida* var. *expansa*, Turner, *M. pinnatifida* var. *inflata*, Wolle, *M. pinnatifida*, Ralfs, *M. arcuata* var. *subpinnatifida*, West & G. S. West, *M. arcuata*, Bail., and *M. arcuata* var. *expansa*, Nordst. The series is complete as we go back through the varieties of *M. pinnatifida* to *M. Rabenhorstii*; and I think there can be no doubt that the latter species is a derivative of *M. Crux-Melitensis*, the intermediate forms being such as those mentioned by Gutwinski *, Raciborski †, and Borge ‡. A figure of *M. Rabenhorstii* var. *tatrica*, also given by Raciborski §, is identical with one semicell of the specimen of *M. Crux-Melitensis* figured by Gutwinski. *Micrasterias incisa*, Bréb., has evidently originated from *M. pinnatifida* var. *inflata*, Wolle, and *M. arcuata* var. *subpinnatifida*, West & G. S. West ||, is a form exactly intermediate between *M. pinnatifida* and *M. arcuata*.

I have already mentioned that many authors have placed *M. pinnatifida* as a variety of *M. oscitans*, but I strongly disapprove this arrangement. It is true that the two species somewhat resemble each other in outline, but they differ greatly in size, in the form of the lateral lobes, and especially in the form of the polar lobes. From these facts, and from the above-mentioned evolutionary series which I have shown to exist, I think that the two species can be justly regarded as occupying two extreme branches in the phylogeny of the species of *Micrasterias*—branches which have undergone a parallelism of modification with regard to external morphological characters, with a result that the majority of authors have failed to discriminate between two well-marked series of forms.

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* R. Gutwinski, "Flora Glonów okolic Lwowa," Spraw. Kom. fizyjogr. Akad. Umiej. Krakow. tom. xxvii. t. 3. f. 28.

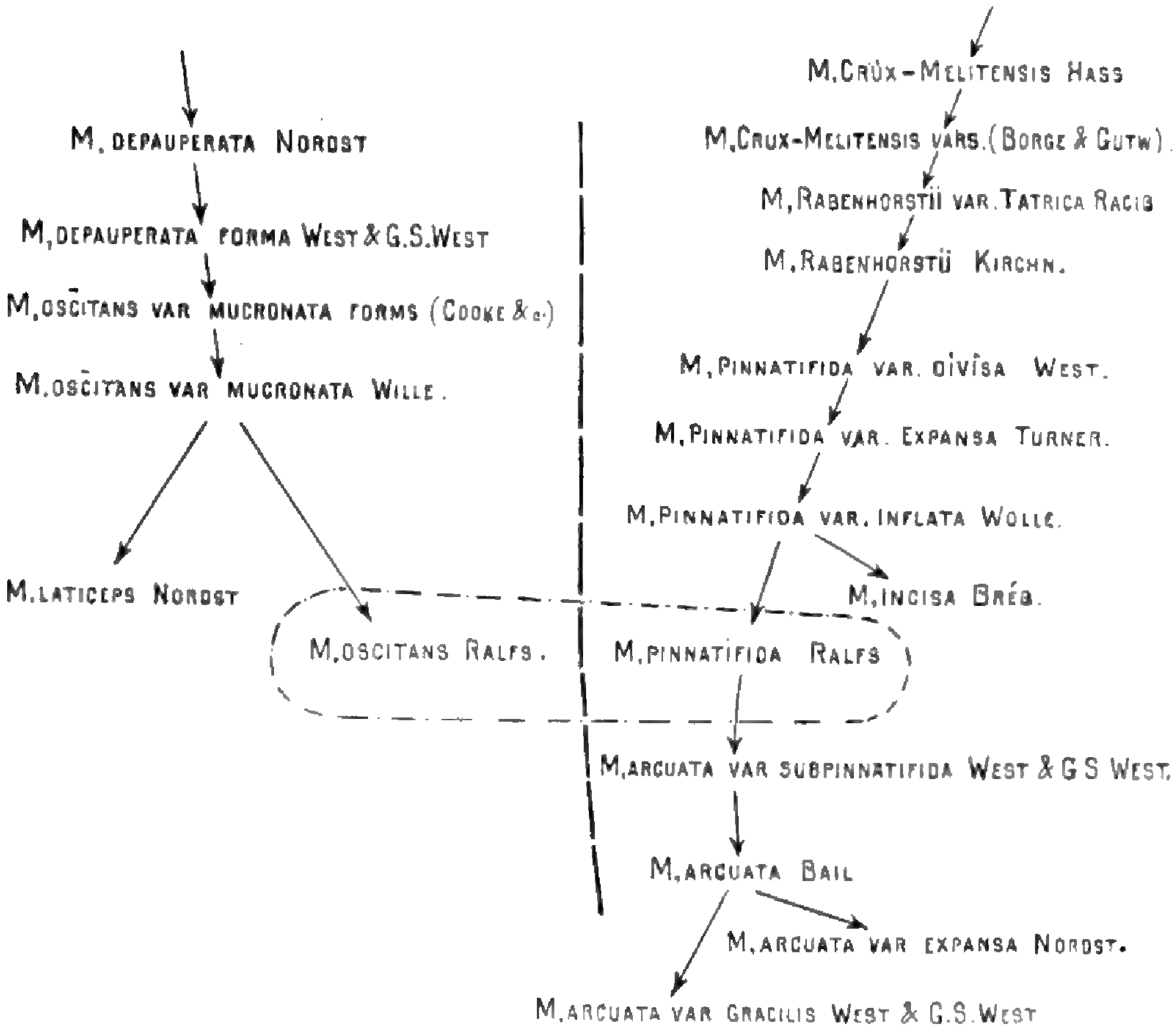
† M. Raciborski, "Desm. Polon.," Pamietnik Akad. Umiej. w Krakowie, Wydz. matem.-przyr. tom. x. 1885, t. 14. f. 4.

‡ O. Borge, "Sussw.-chlor. Archangel," Bih. till K. Sv. Vet.-Akad. Handl. Bd. xix. Afd. iii. no. 5, t. 3. f. 40.

§ M. Raciborski, "Desmidyje Nowe," Pamietnik Wydz. iii. Akad. Umiej. w Krakowie, tom. xvii. 1889, t. 7. f. 2.

|| West & G. S. West, "Welw. Afric. Alg.," Journ. Bot. xxxv. 1897, p. 86, t. 366. f. 7.

I append the following table to illustrate this point:—


M. depauperata Nordst
M, depauperata forma West & G.S.West
M, oscitans var mucronata forms (Cooke &c.)
M, oscitans var mucronata Wille.
M, laticeps Nordst
M, oscitans Ralfs.
M, Crux-Melitensis Hass
M, Crux-Melitensis vars. (Borge & Gutw).
M, Rabenhorstii var. Tatrica Racib
M, Rabenhorstii Kirchn.
M, pinnatifida var. divisa West.
M, pinnatifida var. expansa Turner.
M, pinnatifida var. inflata Wolle.
M, incisa Bréb.
M, pinnatifida Ralfs
M, arcuata var subpinnatifida West & G S West.
M, arcuata Bail
M, arcuata var expansa Nordst.
M, arcuata var gracilis West & G.S.West

I can find only one paper dealing with the question of the general evolution of Desmids, and that by Bougon *. In it he attempts to show by means of a "Généalogie des Desmidiées (de bas en haut)" that the Desmidieæ were originally derived from the Infusoria Flagellata, and that the maximum degree of specialization has been reached by *Hyalotheca dissiliens*! Altogether it is a production testifying to the scant knowledge of the author with regard to the Desmidieæ in general. In the first place, I think it has been almost conclusively proved † that the Desmidieæ are a degenerate family of Algæ which have originated from filamentous conjugates by loss of the filamentous condition ‡, accompanied by the development of specialized morphological characters. It is a notable fact that *Desmidium*

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* Bougon in 'Le Micrographe Préparateur,' vol. v. no. 2, 1897, p. 67.

† West & G. S. West, "Obs. on the Conj.," Ann. Bot. vol. xii. March 1898.

‡ This has been again acquired by about eight genera and several individual species of other genera.

*cylindricum* is the only known Desmid in which the zygospore remains in one of the conjugating cells (presumably the female), and the occasional reversion to this type in *Hyalotheca dissiliens* goes far to prove that in all probability this was the ancestral mode of conjugation in Desmidieæ, and one which has been lost by all except *Desmidium cylindricum*. Secondly, there is undoubtedly no relationship whatever between the genus *Closterium* and the flagellate Infusoria.

Having hinted at the probable descent of the Desmidieæ from filamentous Conjugates, it now becomes expedient to fix upon those genera through which this descent could possibly have been accomplished, and, after due consideration, the genera *Genicularia*, *Gonatozygon*, and *Cylindrocystis* present themselves. I think the two former genera may be regarded as but little removed from the Zygnemaceæ; and although there is much vagueness concerning the origin of *Cylindrocystis*, yet it closely resembles the individual cells of certain species of *Zygnema* *. The main line of evolution from *Cylindrocystis* passed on to the genus *Penium*, an offshoot giving rise to the genus *Mesotænium* and finally to *Spirotænia*. Some may take exception to the view that the genus *Spirotænia* originated from the genus *Mesotænium*, and be constrained to regard the latter genus as derived from the former; *Spirotænia* itself being a derivative either of *Genicularia* or some filamentous conjugate with a spirally-disposed chromatophore. If, however, those species of *Spirotænia* belonging to the subgenus "*Polytænia*" †, in which the chromatophore is cristate, possessing several spiral ridges, be compared with certain species of *Mesotænium* ‡, it is seen that a slight twisting of the chromatophore is all that is necessary to convert such a *Mesotænium* into a *Spirotænia* referable to the subgenus "*Polytænia*." Taking this into consideration along with the fact that species of both these genera are often found associated together amongst mosses on wet rocks, or in *Sphagnum*-bogs, and that the *Mesotænia* are the more predominant, it seems highly probable that at least one series of species of *Spirotænia* were derived from *Mesotænium*.

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* In the early spring these isolated cells of *Zygnema* are frequently met with in mountain-gatherings, and they bear a striking resemblance to the individuals of *Cylindrocystis crassa*, De Bary, not uncommonly found in abundance from the same localities.

† Sect. *Polytænia*, Rabenh. Krypt. Flor. Sachs. 1863, p. 178; Turner in Kongl. Sv. Vet.-Akad. Handl. Bd. 25, no. 5, 1893, p. 23 (subgen.); Lütkemüller, "Ueber die Gattung *Spirotænia*," Oesterr. botan. Zeitschr. xliii. 1895, p. 92 (subgen. *Polytænia*).

‡ Especially such a species as *M. macrococcum*, Kirchn. (=*M. Braunii*, De Bary, Conj. p. 74, t. 7 A. ff. 1–8).

From *Penium* there are two offshoots, one terminating in *Roya* and the other passing through *Closterium* to *Pleurotænium* and *Docidium*; but the main line of descent passes on direct from *Penium* to *Tetmemorus*, the latter genus ultimately giving rise to *Euastrum* through such forms as *Tetmemorus fissus* * and *Euastrum giganteum* †. From *Tetmemorus* we get an offshoot of two rare genera, first *Ichthyocercus*, and from it, *Triploceras*.

With regard to the large genus *Cosmarium*, embracing as it does a multitude of forms, I think there can be little doubt that it originated from *Euastrum*, many species being met with intermediate between these two genera ‡; and that the genus *Micrasterias* was similarly derived from *Euastrum* is clearly indicated by the presence of such species as *Micrasterias Moebii* and *M. euastroides* §. The genus *Cosmocladium* has unquestionably arisen as a solitary offshoot from *Cosmarium*; and it is highly probable that another small offshoot accounts for the genera *Spondylosium* and *Phymatodocis*, the main line of descent passing along two courses, one to the genus *Xanthidium* and the other to the genus *Staurastrum*.

The genus *Xanthidium* has been derived chiefly from *Cosmarium* and probably in part from *Micrasterias*. Some forms of the species *Xanthidium concinnum* and *X. Robinsonianum* are very closely allied to *Cosmarium Heimerlii* and *C. sphagnicolum*, and

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* *Tetmemorus fissus*, West & G. S. West, "Welw. Afric. Alg.," Journ. Bot. 1897, p. 81, t. 368. f. 25.

† *Euastrum giganteum*, Nordst. in De Toni, Syll. Algar. p. 1106 (1889); *Tetmemorus giganteus*, Wood, in Proc. Acad. Nat. Sci. Philad. 1870, p. 19.

‡ Cfr. *Euastrum cosmaroides*, West & G. S. West, "Alg. Madag.," Trans. Linn. Soc. ser. II. Bot. vol. v. p. 54, t. 6. f. 23; *E. subornatum*, West & G. S. West, "N.-Amer. Desm." *l. c.* vol. v. p. 245, t. 14. f. 40; *Cosmarium sublobatum*, Arch. in Pritch. Infus. ed. 4, 1861, p. 731 (=*Euastrum sublobatum*, Bréb. in Ralfs Brit. Desm. 1848, p. 91, t. 32. f. 4); *C. subbinale*, Lagerh., "Chloroph. aus Abessin. u. Kordofan," Nuova Notarisia, ser. iv. p. 164; *C. genuosum*, Nordst., "Algolog. småsak.," Botan. Notiser, 1887, p. 161.

§ *Micrasterias Moebii*, West & G. S. West, "Desm. Singapore," Journ. Linn Soc., Bot. vol. xxxiii. 1897, p. 162; *M. euastroides*, Josh., "Burm. Desm.," Journ. Linn. Soc., Bot. vol. xxi. 1886, p. 637, t. 22. f. 14.

Turner states *, with regard to his *Xanthidium cosmariforme*, that it "might just as correctly be called *Cosmarium xanthidiforme*." Such species as *Xanthidium armatum*, Rabenh., and *X. bifurcatum*, Borge †, bear such a striking resemblance to *Micrasterias anomala*, Turner, that no doubt can exist as to their close relationship.

It is highly probable that the large genus *Staurastrum* is a diphyletic assemblage, being derived partly from *Cosmarium* and most probably in part from *Xanthidium*. The direct transition from *Cosmarium* to *Staurastrum* is exhibited by the triangular varieties of *Cosmarium biretum*, *C. costatum*, *C. pseudoprotuberans*, &c. ‡, and by *Staurastrum cosmarioides* §, *S. orbiculare*, *S. muticum*, *S. acarides*, &c., not to mention the close resemblance existing between *Cosmarium cylindricum* and a six-ended form of *Staurastrum Meriani*, or the puzzling characters of such species as *Staurastrum areolatum* or *S. Laconiense*. A transitional form between *Xanthidium* and *Staurastrum* is illustrated by the triangular variety of *Xanthidium antilopæum* ‖, the earliest indication of the production of triangular forms along this line of descent being seen in *Micrasterias* and even in *Euastrum* ¶.

From the genus *Staurastrum* there is a small offshoot to the genus *Dichotomum*, but a line of descent also passes to *Arthrodesmus*, a genus which unquestionably derives its species partly from *Staurastrum* (although mostly from *Xanthidium*). Several species of *Arthrodesmus* with smooth cells and lateral spines resemble very closely such species of *Staurastrum* as *S. dejectum*,

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* Kongl. Sv. Vet.-Akad. Handl. Bd. xxv. no. 5, 1893, p. 99.

† O. Borge in Bih. till K. Sv. Vet.-Akad. Handl. Bd. xxii. Afd. iii. no. 9, p. 16, t. 2. f. 24.

‡ *Cosmarium biretum* var. *triquetrum*, Bréb. in Mém. Soc. Sci. nat. Cherbourg, iv. 1856, p. 130, t. 1. f. 9. *C. costatum* var. *triquetrum*, Nordst. in Öfvers. af K. Sv. Vet.-Akad. Förh. 1875, no. 6, p. 25 (= *C. abnorme* var. *triquetrum*, Nordst., 1872). *C. pseudoprotuberans* var. *trigonum*, Nordst. "Desm. Grönl.," *l. c.* 1885, no. 3, p. 7, t. 7. f. 2.

§ *Staurastrum cosmarioides*, Nordst., "Desm. Bras.," Vidensk. Medd. f. d. nat. Foren. Kjöbenhavn, 1869, p. 223, t. 4. f. 43, very much resembles a triangular variety of *Cosmarium pyramidatum*, Bréb.; consult also the remarks made by Bœrgesen in Vidensk. Medd. Foren. Kjöbenh. 1890, pp. 49–50, c. ff. 1–6.

‖ *X. antilopæum* var. *triquetrum*, Lund. in Acta Soc. Scient. Upsal. 1871, p. 76, t. 5. f. 6; Wolle, Desm. U. S. 1884, t. 22. ff. 1–3.

¶ Cfr. *M. pinnatifida* var. *trigona*, West in Journ. Bot. xxvii. 1889, p. 206, t. 291, f. 15; and *E. humerosum* forma *triquetra*, Schröder in Forschungsberichten der Plöner Biol. Stat. 1897, p. 38, t. 2. f. 3.

*Staurastrum Dickiei*, &c.; so much so that Meneghini*, and afterwards Jacobsen†, were induced to regard *Arthrodesmus Incus* as a species of *Staurastrum*, and Nordstedt and Löfgren‡ were undecided under which genus to place *Arthrodesmus psilosporus*. The main line of descent from *Xanthidium* to *Arthrodesmus* is conspicuously evident by the occurrence of species which have been referred, with almost equal rectitude, to each of these genera§; and it may be well here to emphasize the fact that although species belonging to either of these genera are as a rule easily distinguishable, yet the only valid difference between the two genera is the presence of the central protuberance in *Xanthidium*‖ and its entire absence in *Arthrodesmus*.

The genus *Onychonema* is a natural derivative of *Arthrodesmus*, by the development of the apical processes and consequent assumption of a filamentous condition, and a slight reduction of these apical processes would result in the formation of the genus *Sphærozosma*, the connecting processes of *S. Aubertianum* var. *Archerii* being of exactly the same nature as those of an *Onychonema*¶. In the evolution of the genus *Streptonema* the apical processes were further specialized, and a modification of these structures to form broader projections of the apical part of the cell-wall resulted in the production of those species now placed under the genus *Desmidium*. This view I have further confirmed by the examination of a species of *Desmidium* from Ceylon, exactly intermediate between this genus and *Streptonema*. In some species of *Desmidium* the broad apical processes are very

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* Meneghini, "Synops. Desm.," Linnæa, 1840, p. 228.

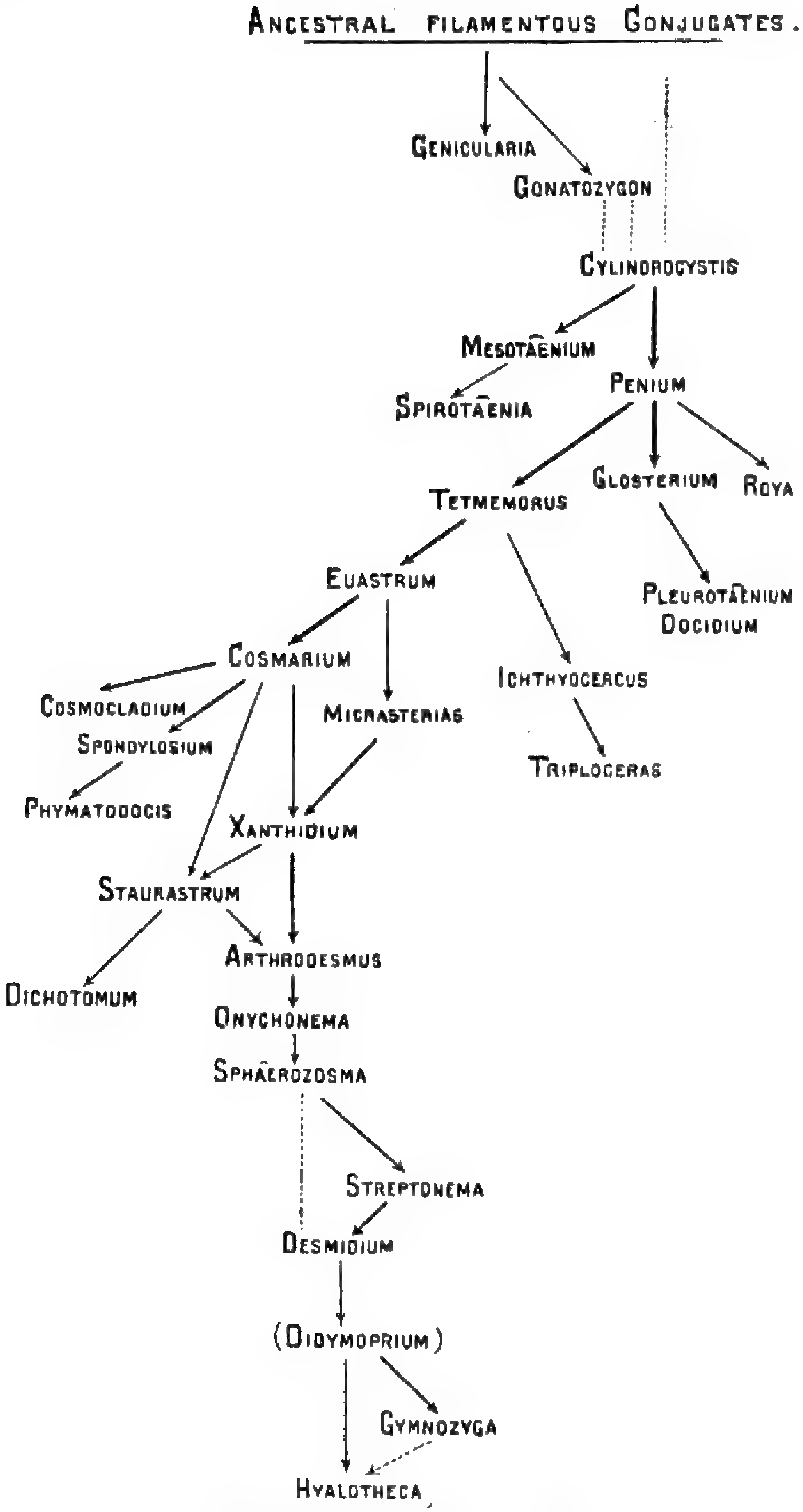
† Jacobsen, "Desm. Danm.," Botanisk Tidsskrift, vol. viii. 1874, p. 204.

‡ Nordstedt & Löfgren in Wittr. & Nordst. Alg. Exsic. 1883, No. 558, c. fig.

§ *Xanthidium tetracentrotum*, Wolle, Desm. U.S. p. 95, t. 22. ff. 8–9, and *Arthrodesmus incrassatus*, Lagerh. in Öfvers. af K. Sv. Vet.-Akad. Förh. 1885, no. 7, p. 242, t. 1. f. 18; *cfr.* West & G. S. West in Trans. Linn. Soc., Bot. ser. II. vol. v. p. 253, t. 15. f. 24. Also *Xanthidium acanthophorum*, Nordst. in Acta Univers. Lund. vol. xvi. 1880, p. 11, t. 1. f. 20; referred by Raciborski to *Arthrodesmus* in Pamietnik Wydz. iii. Akad. Umiej. w Krakowie, tom. xvii. 1889, p. 97, t. 6. f. 18.

‖ There are, however, a few species of *Xanthidium* without this central protuberance (*X. leiodermum*, Roy. & Biss., *X. bengalicum*, W. B. Turn.), and many others in which it is only slightly developed.

¶ *Cfr.* West & G. S. West in Trans. Linn. Soc., Bot. ser. II. vol. v. p. 230, t. 12. ff. 7–8; Gutwinski in Sprawozd. Kom. fizyj. Akad. Umiej. w Krakowie, tom. xxvii. p. 29, t. 1. f. 4.


Ancestral filamentous Conjugates.
Genicularia
Gonatozygon
Cylindrocystis
Mesotaenium
Spirotaenia
Penium
Closterium
Roya
Tetmemorus
Euastrum
Pleurotaenium
Docidium
Cosmarium
Ichthyocercus
Cosmocladium
Micrasterias
Spondylosium
Triploceras
Phymatodocis
Xanthidium
Staurastrum
Arthrodesmus
Dichotomum
Onychonema
Sphaerozosma
Streptonema
Desmidium
(Didymoprium)
Gymnozyga
Hyalotheca

*Phylogeny of the Genera of Desmids.*

much reduced in length, and a total suppression of them resulted in the genus *Didymoprium*, the latter genus ultimately producing *Gymnozyga* by an elongation of the cells. *Hyalotheca dissiliens* may probably have had an origin from *Didymoprium quadratum*, *D. æquale*, or some allied form, and other species of *Hyalotheca*, such as *H. neglecta*, which so nearly resembles a species of *Gymnozyga*, may have had an origin from the latter genus. At present, however, we know very little about many of the filamentous Desmidieæ, and for this reason any remarks as to their origin must necessarily be mostly conjectural.

The accompanying table (p. 414) of the phylogeny of the genera of Desmids may serve to illustrate the foregoing hypothesis.

## EXPLANATION OF THE PLATES.

$a, a', a''$ = cell or semicell from front view.
$b, b', b''$ = „ „ „ vertical view.
$c$ = „ „ „ side view.
$d$ = basal view of semicell.

### Plate 8.

Figs. 1–12. *Penium spirostriolatum*, Barker. 1, specimen from Oughtershaw Tarn, W. Yorks., ×520; 2, from Llyn Padarn, N. Wales, ×520; 3, from Castletown, S.W. Ireland, ×520; 4, from Minnesota, U.S.A., ×520; 5, from Cromagloun, S.W. Ireland, ×520; 6, one apex of fig. 5, ×830; 7, from Cromagloun, S. W. Ireland, ×520; 8–10, apices of three specimens from Oughtershaw Tarn, W. Yorks., ×1280; 11–12, portions of cell-wall of a specimen from Llyn Padarn, N. Wales, ×1280.

„ 13–19. *Euastrum Didelta*, Ralfs. ×220. 13, specimen from Thursley Common, Surrey; 14, from Blea Tarn, Westmoreland; 15 & 16, from near Clapham, W. Yorks.; 17, from Widdale Beck, N. Yorks.; 18 & 19, from Castletown, S.W. Ireland.

„ 20–22. *Xanthidium Smithii*, Arch., var. *variabile*, Nordst. ×520. 20, specimens from Esher Common, Surrey; 21 & 22, from near Devil's Jumps, Frensham, Surrey.

### Plate 9.

Figs. 1–8. *Micrasterias Thomasiana*, Arch., and intermediate forms between this species and *M. denticulata*, Bréb. 1 & 2, specimens from Terrington, N. Yorks., ×170; 3 & 4, from Wrynose, Lancashire, ×170; 5, from Thursley Common, Surrey, ×170; 6, from Singapore, ×390; 7 & 8, from Glen Shee, Perthshire, Scotland, ×300 (8 *d* is slightly oblique).

Figs. 9–16. *Micrasterias truncata*, Bréb. ×220. 9, specimen from Widdale Beck, N. Yorks.; 10, from near Clapham, W. Yorks.; 11, from Bowness, Westmoreland; 12, from Glen Shee, Perthshire, Scotland; 13, from Llyn Padarn, N. Wales; 14, from Capel Curig, N. Wales; 15, from Thursley Common, Surrey; 16, from Minneapolis, Minnesota, U.S.A.

## Plate 10.

Figs. 1–6. *Cosmarium læve*, Rabenh. ×520. 1 & 2, specimens from near Paris; 3–6, from Hanka Deela, Somaliland.

„ 7–9. *Cosmarium læve*, Rabenh., var. *septentrionale*, Wille. ×520. 7, specimen from Cocket Moss, near Giggleswick, W. Yorks.; 8, from Epping Forest, Essex; 9, from Borrowdale, Cumberland.

„ 10–21. *Cosmarium Regnesii*, Reinsch, and many forms intermediate between the type and var. *montanum*, Schmidle. ×1280. 10–17, specimens from Puttenham Common, Surrey; 13–17, showing peculiarities in division of cells; 18 (very large form) and 19, from Riccall Common, E. Yorks.; 20 and 21 (very large form) from Pilmoor, near Thirsk, N. Yorks.

„ 22–28. *Cosmarium biretum*, Bréb. ×520. All the specimens from the lake, Welsh Harp, Middlesex.

„ 29–34. *Cosmarium biretum*, Bréb., var *trigibberum*, Nordst. ×520. 29–31, and 34, specimens from The Washes, Sutton, Cambridgeshire; 32, from Whiteley Common, Surrey; 33, from Roundhay Park, Leeds, W. Yorks.

„ 35–36. *Staurastrum furcigerum*, Bréb., one semicell typical and the other with six superior processes (as in forma *eustephana*, Nordst.). ×520. 35, specimen from Birkhouse Moor Tarn, Helvellyn, Westmoreland; 36, from Pilmoor, near Thirsk, N. Yorks.

## Plate 11.

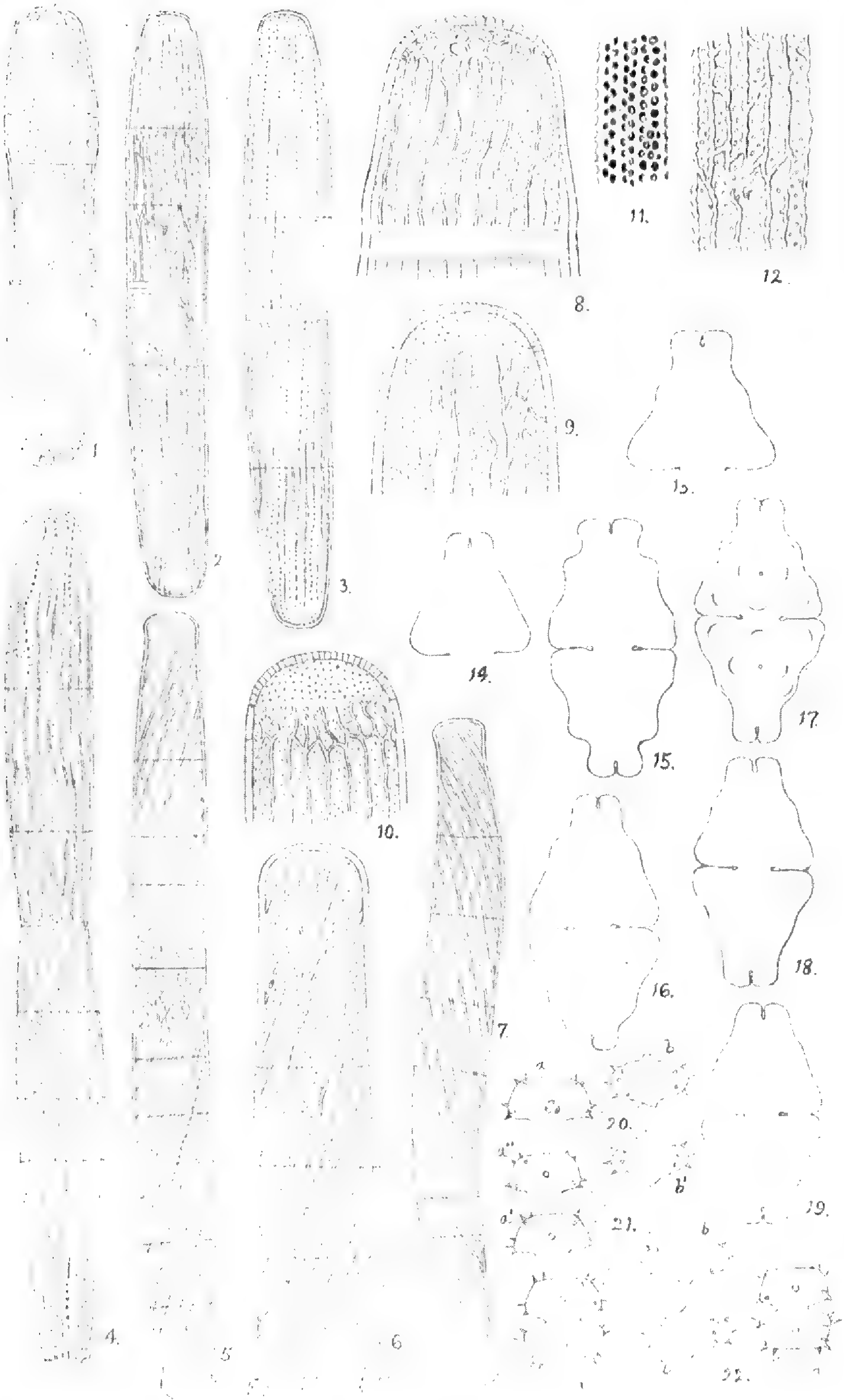
Figs. 1–4. *Cosmarium orthostichum*, Lund. ×520. 1, specimen from Thursley Common, Surrey; 2, from Ballynahinch, Connemara, Ireland; 3, from the United States; 4, from the New Forest, Hants.

„ 5–15. *Staurastrum brachiatum*, Ralfs. ×520. 5–8, specimens from near Devil's Jumps, Frensham, Surrey; 9, from Slieve Donard, Mourne Mts., Co. Antrim, Ireland; 10, from Orono, Maine, U.S.A.; 11, from Puttenham Common, Surrey; 12, from Thursley Common, Surrey; 13–15, from Penzance, Cornwall.

„ 16–20. *Staurastrum Reinschii*, Roy. ×520. 16 & 17, specimens from near Devil's Jumps, Frensham, Surrey ($17b''$ is slightly oblique); 18 & 19, from Lund's Fell, N. Yorks. ($19b'$ is oblique); 20, from Roughton Moor, Cornwall.

„ 21–27. *Staurastrum crenulatum*, Delp. ×520. All specimens from Roundhay Park, Leeds, W. Yorks.

„ 28–32. *Staurastrum aculeatum*, Menegh. ×520. 28 & 29, specimens from Orono, Maine, U.S.A.; 30, from Thursley Common, Surrey; 31, from Capel Curig, N. Wales; 32, from Minneapolis, Minnesota, U.S.A.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G. S. W. del.                Ferrier.

VARIATION IN THE DESMIDIEÆ.

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G. S. W. del. Ferrier.

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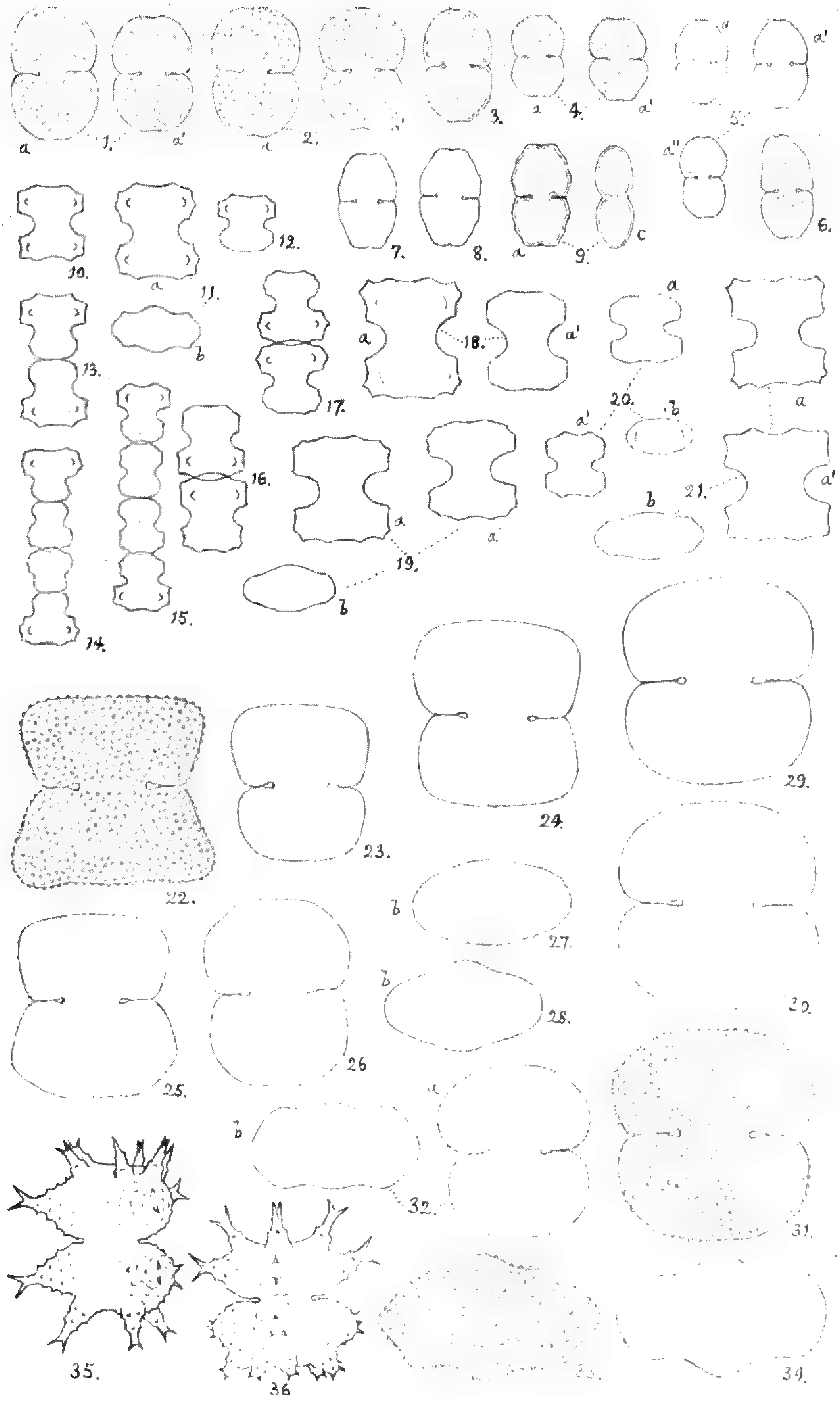
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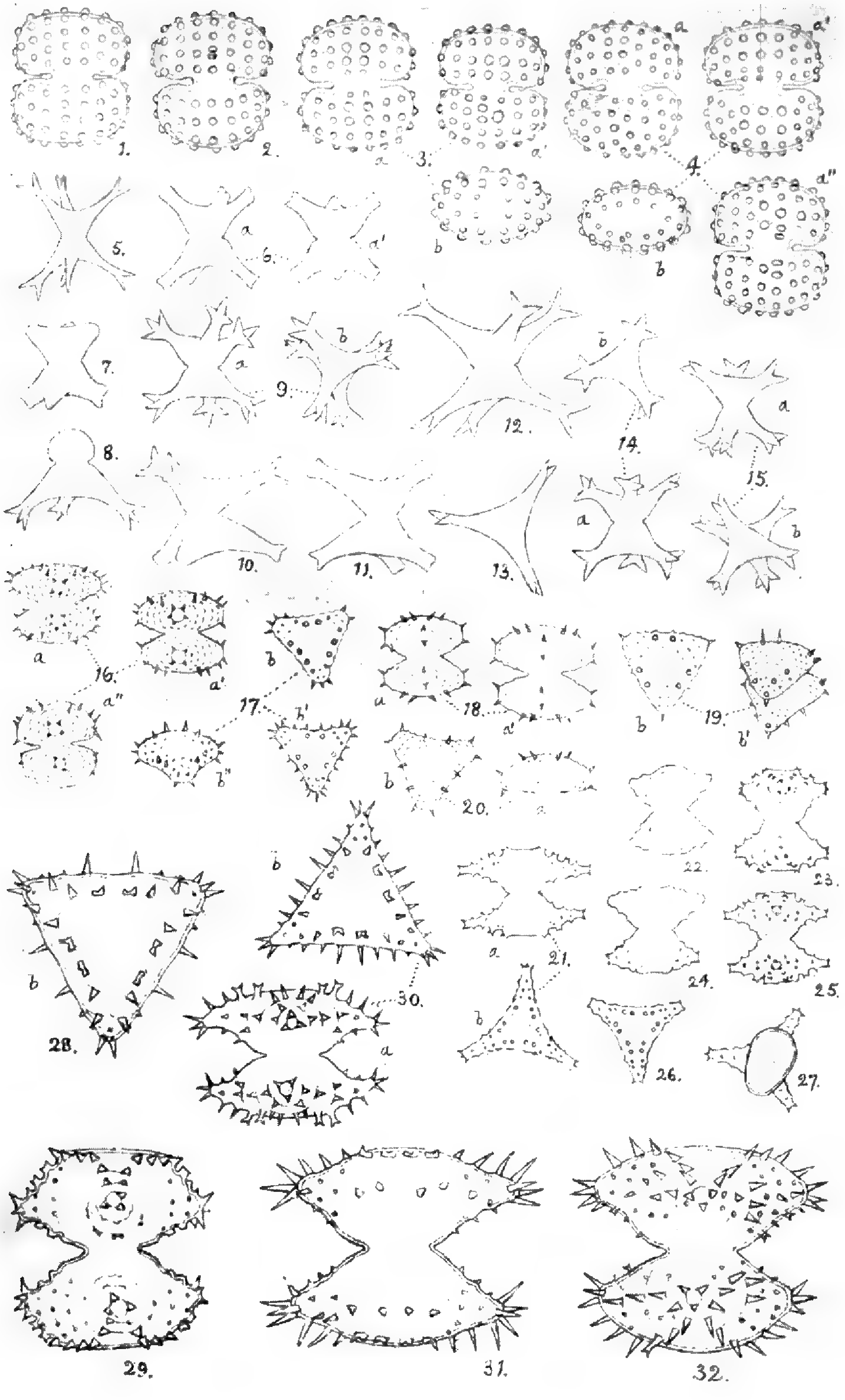
*G. S. W. del.* *Ferrier.*

VARIATION IN THE DESMIDIEÆ.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*G. S. W. del.* *Fenner.*

VARIATION IN THE DESMIDIEÆ.

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Vol. XXVIII., Nos. 189–196. (Complete.)

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OF

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NOTE.—The Charter and Bye-Laws of the Society, as amended to the 19th March, 1891, may be had on application.

## On *Notheia anomala*, Harv. et Bail. By ETHEL SAREL BARTON. (Communicated by GEORGE MURRAY, Esq., F.R.S., F.L.S.)

[Read 4th May, 1899.]

(PLATES **12–14**.)

THE Fucaceous genus *Notheia* was founded by Harvey and Bailey on the species *N. anomala*, and published in the United States Exploring Expedition (Capt. Wilkes), vol. xvii. Botany, **1862**, p. **157**. The authors describe it as parasitic on *Hormosira Sieberi*, and remark on the unusual mode of growth, in which "each branch rises as it were viviparously from the scaphidium of a previous branch." They doubt here whether it may not be some spurious production of the host-plant, but in a note added later, *loc. cit.*, Dr. Harvey expresses himself as satisfied that "*Notheia* is really a parasitic alga and not a metamorphic state of *Hormosira*." Four figures are given of *Notheia*, among which is one of "a perispore with paranemata." This evidently represents an antheridium, for it contains a large number of regularly arranged cells, and the text describes the fruit as consisting of "spores in very narrow, almost linear, slightly obovate, almost parietal perispores."

The next records are in Hooker's 'Flora of New Zealand,' vol. ii. 1855, p. 215, and Hooker's 'Handbook of the New Zealand Flora,' 1864, p. 653, which, however, add nothing to the description of Harvey and Bailey. In "Observations on the Fucoideæ of Banks Peninsula" (Transactions of the New Zealand Institute, vol. xviii. 1885, p. 308), Mr. Laing gives a short account of *Notheia*. He quotes Hooker's description in the 'Handbook' (*l. c.*), and for the first time records the oogonia, which he also figures. He says, however, that from lack of good material he could not verify the number of oospheres in each oogonium.

This point is decided by Miss Mitchell in a note on *N. anomala* (Murray's 'Phycological Memoirs,' pt. ii. p. 36, 1893). She finds eight oospheres in each oogonium, though their arrangement, as figured by her, does not agree with the result of my investigations, to be described later. She gives good figures, natural size, of *Notheia* growing on its two hosts, *Hormosira* and *Xiphophora*.

Kjellman (Engler and Prantl's Natürl. Pflanzenfam. i. Abt. II. p. 280, 1891) and De Toni (Sylloge Algarum, vol. iii. Fucoid. p. 224) summarize the previous knowledge of *N. anomala*, but do not add to it.

In the 'Bibliotheca Botanica' a paper, "Ueber Aufbau und Entwickelung einiger Fucaceen," by Dr. Eduard Gruber, contains a short account of *Notheia*. He deals mainly with the growing-point and the development of the conceptacles, describing also the growth of the young branch. He mentions the oogonia only, and regards the plant as probably diœcious. The parasitism of *Notheia* is passed over, and no account is given of the early stages inside the host-plant.

This paper of Dr. Gruber was brought to my notice after my own investigation had been completed, and was therefore the more interesting as affording an opportunity of comparing results in the few points where our work had overlapped. I venture to differ from Dr. Gruber in a few details, but in the matter of the growing-point he was right and I wrong. These differences will be dealt with as they arise.

*Notheia anomala* is recorded from Australia, Tasmania, and New Zealand as parasitic on *Hormosira* and *Xiphophora*; and specimens from these localities are preserved in the British Museum, collected by Dr. Harvey, Mr. Bracebridge Wilson, and Mr. Laing. The last-named collector tells me in a letter that he has never found *N. anomala* parasitic on any other alga than *Hormosira*, though he has seen large quantities of *Xiphophora* in a living state.

The material on which this investigation was made was in part collected by Mr. Bracebridge Wilson at Geelong, Australia, and in part by Mr. W. R. Laing, of Christchurch, New Zealand, who has most kindly sent me supplies of material preserved according to various methods. He has also given me the benefit of his own observations made on living material, for which I here offer him my grateful thanks; but especially am I indebted to him for his generosity in sending me the material for a research which could have been so ably carried out by himself.

*Notheia anomala* is a slender, branched alga from 5–8 cm. high, though, according to De Toni, sometimes attaining a height of 15 cm. The largest plants I have seen do not exceed 12 cm., and in general they do not by any means reach this height. The mature stem is about 1½ mm. in diameter and is branched at intervals in no particular order, each branch again throwing out smaller branchlets. These taper considerably both at their apex and at their point of connection with the stem, giving the whole plant a rather fragile appearance (Pl. **12.** fig. 1).

The thallus of *N. anomala* consists of three layers of tissue, as in *Turbinaria* and other members of Fucaceæ. The centre is occupied by the usual strand of elongated cells having very thin transverse and thick longitudinal walls. The breadth of this strand increases with the age of the plant, and in the oldest portions of the thallus the thick walls become much pitted, while other filaments arising from them intertwine irregularly among them (Pl. **12.** figs. 2 & 3). These filaments, or "hyphæ" as Prof. Oltmanns calls them, have been described and figured by him for *Ascophyllum nodosum* ("Beitr. z. Kenntn. der Fucaceen," Bibl. Bot., Heft 14, 1889, pl. x. fig. 1). The layer immediately surrounding the central strand consists in the young plant of roundish cells with pits in their walls, and as the thallus increases in age the cells become longer and the walls thicker, thereby showing up in marked contrast the thin places in the cell-walls (Pl. **12.** fig. 2 *b*). The cortical layer shows the usual narrow, radially elongated cells.

The growing-point of *N. anomala* does not lie at the base of a depression as in many of the Fucaceæ, but forms the topmost point of the thallus. It consists of three apical cells, as has been shown by Dr. Gruber (*l. c.*), who figures the growing-point both in transverse and longitudinal section, and compares it with that of *Hormosira*, which has three or, more often, four apical cells. My own conclusions with regard to the apex of *Notheia* were, as stated above, different from those of Dr. Gruber, since I believed that there was but one apical cell; but after reading his paper and re-examining the series of sections, there is no doubt as to the correctness of his decision. The division of these apical cells takes place, according to Dr. Gruber, by the cutting off of cells at the periphery, and these then divide by radial and basal walls to form the various layers of tissue.

Immediately below the apex of *N. anomala* may be seen the first appearance of young cryptostomata, also described by Dr. Gruber. They arise in the usual way by the arrested growth of one of the epidermal cells, which at once produces a hair with a large basal cell (Pl. **13.** fig. 4). The depression enlarges by longitudinal division and subdivision of this arrested epidermal cell, thus forming a layer which lines the cavity. Each of these cells produces a hair in the young cryptostoma, thus forming a thick tuft of long hairs which protrude through the mouth and are plainly visible to the naked eye in the young branches of the plant (Pl. **12**. fig. 5).

In some of the cryptostomata, however, a cell which lies at the base of the depression, instead of producing a hair, grows up into a small round protuberance, and after division proceeds to cut off from the apex successive cells to form a young branch (Pl. **13**. fig. 6). These apical cells are exactly similar to those of the primary thallus, as would be expected. As growth in length takes place, the lower cells begin to divide up to form the various layers of tissue, and this transverse division keeps pace with a corresponding division of the cryptostoma-cell, which originally gave rise to the branch. So that before the young branch is sufficiently advanced to protrude through the opening of the cryptostoma its base has become quite broad, and gives the appearance of having originated from a group of cells rather than from a single cell (Pl. **13**. fig. 7). The remaining cells of the cryptostoma continue to produce hairs as usual.

In Dr. Gruber's description of the young cryptostoma and the origin of the branch he says that when the hairs fall off a flask-shaped cell is left at the base, which probably gives rise to the young branch. But the hairs do not fall off in the very early stages of the cryptostoma, and it is in these stages that the first sign of the branch is seen. There seems to me no doubt that the branch arises direct from one of the cells of the lining layer.

Since the branching takes place in this way from the cryptostomata, it follows that branches arise from all sides of the thallus irregularly; indeed I have seen in one section three cryptostomata with a branch growing out of each. In one instance of an old cryptostoma I have seen the centre occupied by the base of a thick branch and at the side there was beginning to shoot up another small branch, showing that one cryptostoma can produce more than one branch, and that these need not necessarily spring from the centre. I have failed, however, to find a case in which two branches have succeeded in growing to maturity from the same cryptostoma.

All this time the cells lining the cavity of the cryptostoma have continued to divide, as well as the thallus-cells surrounding it. The large area of lining-cells thus produced shows of course very few hairs, for many of these have fallen off and the remainder have become separated from each other by the formation of the new cells. From these there now push up small outgrowths which develop into antheridia, oogonia, and unbranched paraphyses (Pl. **13**. fig. 8).

Dr. Gruber describes the growth in size of the cryptostoma (or, as he calls it throughout, the conceptacle) as taking place through separation from each other of the cells surrounding the initial cell. My observations lead me rather to the conclusion that repeated cell-division of the lining layer and, later on, a growth in size of the individual cells take place, thus accounting for the appearance of new hairs, and later on of reproductive organs, from all parts of the cavity. In mature conceptacles the walls of the lining-cells are still connected with each other at their base, while the upper part becomes free by pushing up into the open space of the cavity. By this means the actual surface area of each such lining-cell is enlarged, and one cell can thus bear an oogonium and one or even two paraphyses.

As I have pointed out above, the bodies which we now know to be antheridia were probably first noted by Harvey and Bailey, since the figure (*l. c.*) evidently refers to these bodies under the name of sporangia. They arise direct from the lining-cell of the cryptostoma, or conceptacle as it has now become, and contain numerous antherozoids (Pl. **13**. fig. 9). They are about 55 μ long and 15 μ broad, resembling entirely the antheridia of *Hormosira* and other Fucaceæ. They grow in the same conceptacles as the oogonia, but are not so plentiful. This is, so far as I know, the only recorded case of antheridia growing directly from the walls of the conceptacle in the same manner as oogonia; and it was not until after an examination of a large number of conceptacles that I felt justified in regarding these bodies as antheridia and not as oogonia, of which the cell-contents had been in some way disorganized. But the regularity of the antherozoids, and the final confirmation of their existence in fresh material by Mr. Laing, placed the question beyond doubt.

The general rule as to the position of the reproductive organs in Fucaceæ, *i. e.*, that the antheridia arise on branched hairs and the oogonia from the walls of the conceptacle, is now shown to have exceptions in both cases. *Notheia* has antheridia arising like oogonia, while *Sarcophycus* (Miss F. G. Whitting, in

Murray's Phycol. Mem. p. 39, pl. 12. fig. 3) and *Durvillæa* (Laing, in Trans. N. Z. Inst. xviii. (1885) p. 308) have oogonia on branched hairs like antheridia.

The oogonia of *Notheia* are rather larger than the antheridia and measure 75 $\mu$ by 20 $\mu$. They contain 8 oospheres, one at each end, and, between these, three groups of two each, the oospheres of the two outermost groups corresponding in position, while in the middle group the oospheres lie crossways. Thus if the two outermost groups show both oospheres side by side, the middle group shows only one, the second oosphere being hidden behind it (Pl. **13**. fig. 10).

The unbranched paraphyses are of the usual size and kind found in female conceptacles, and frequently grow from the same cell which bears the antheridium or oogonium, as mentioned above.

One or two of the long cryptostoma-hairs sometimes persist during the time of fructification and may be seen among the ripe fruits (Pl. **13**. fig. 8).

The history of cryptostomata has aroused a certain amount of discussion and speculation; and there is still much to learn about their origin and function from the more or less open pits of Encœliaceæ to the flask-shaped cavities of Fucaceæ—all with their typical cryptostoma-hairs. But till now I believe it has not been found that all the cryptostomata of any Fucaceous alga gradually lose most of their hairs and come to bear reproductive organs and paraphyses—become, in fact, fertile conceptacles. Miss Strudwick, who examined *Hormosira* at my request with regard to this point, tells me it is true also of that genus. This has been seen in *Splachnidium* (Murray's Phycol. Mem. pt. i. 1892, p. 5), but in that case the reproductive organs are sporangia, and the genus is therefore excluded from Fucaceæ. Of the three views concerning the origin of cryptostomata quoted by Mr. Murray ("On the Cryptostomata of *Adenocystis, Alaria,* and *Saccorhiza,*" Phyc. Mem. 1893, p. 59), my own, as to the phylogenetic independence of cryptostoma and conceptacle, must, I fear, fall to the ground before this new light thrown on the subject by *Notheia.*

Prof. Oltmanns's view "that the fertile conceptacles are cryptostomata which have in time come to bear organs of reproduction," seems to meet the case more satisfactorily, especially if we remember how the sporangia of *Adenocystis, Soranthera, Colpomenia,* *Chnoospora*, &c. cluster round the mouth of the cryptostomata. It only needs a step for the fruits to drop into the cavity in their midst, and thus convert the cryptostoma into a fertile conceptacle. This view, on the other hand, does not account for the cryptostomata of *Fucus*, *Turbinaria*, &c., which might be claimed by Prof. Bower in support of his theory that cryptostomata are incomplete sexual conceptacles.

That these hairs are of importance to many members of the Phæophyceæ is evident by the careful protection they receive; but the manner in which they serve the plant has yet to be discovered. The subject of cryptostomata and their hairs is, however, dangerous ground for speculation, but it is hoped that new facts concerning these bodies may eventually throw a clearer light on their origin and function.

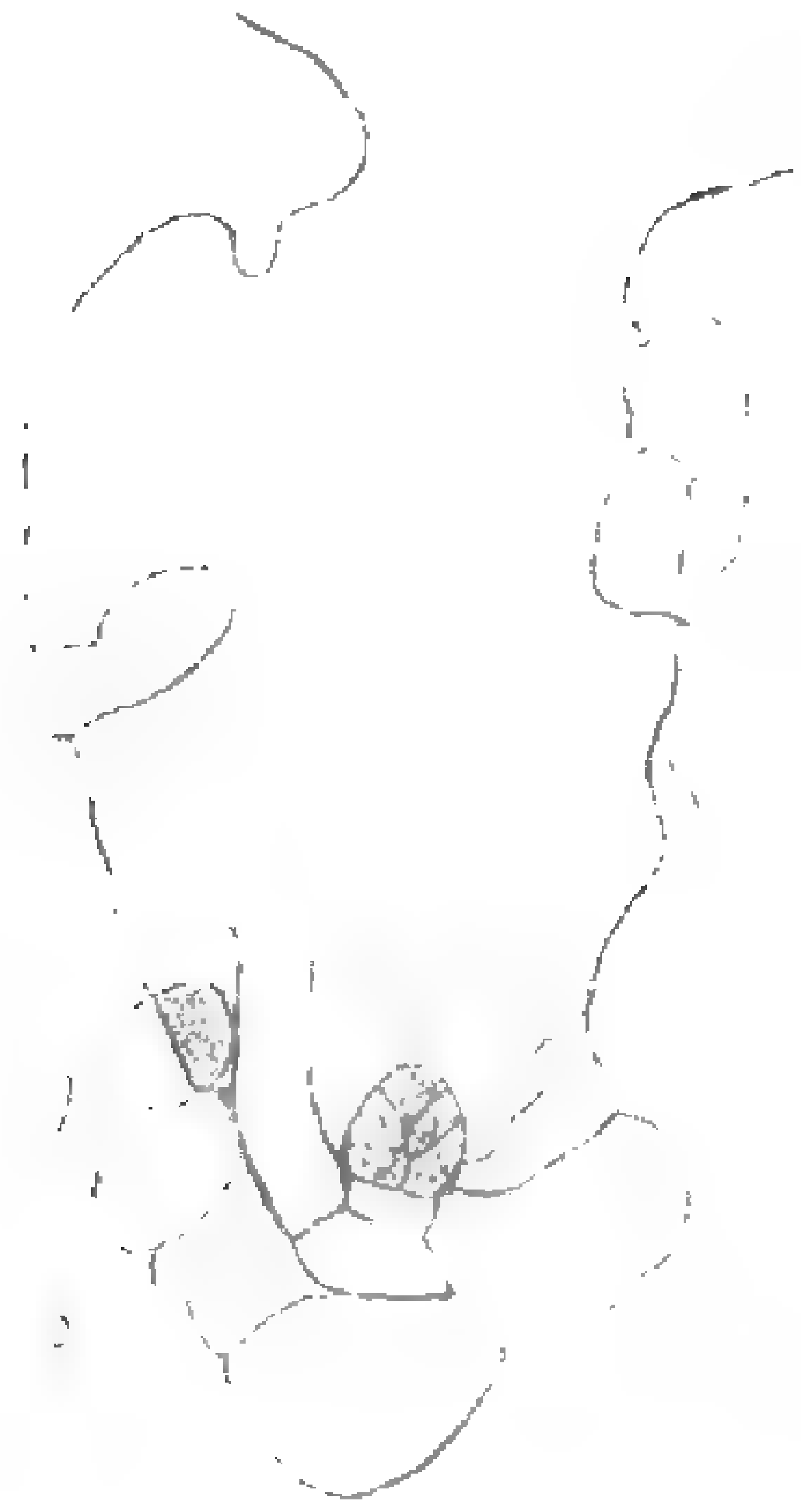
*Notheia anomala* has long been known as the only recorded parasite among the Fucaceæ, but details of this parasitism have been wanting. Hooker (Handbook N. Z. Flora, *l. c.*) says it grows from the conceptacles of its host *Hormosira*; but after examining a large number of instances of the junction between host and parasite, I find this statement incorrect. The point of entry is in most cases quite close to the mouth of a cryptostoma or conceptacle of *Hormosira*, but in no case have I seen any part of *Notheia* penetrate into the conceptacle itself of the host-plant. In the earliest stages, the spore apparently divides on the surface of the host and throws out a delicate septate filament, which penetrates between the host-cells and branches in every direction; thus forming a sort of loose network, without, however, actually penetrating into the host-cell. By means of offshoots running up to the surface of the host, from one of the filaments of *Notheia*, the gelatinous cuticular layer of the host-plant is thrown off and room is made for the parasite to develop. Meanwhile several of the filaments inside the host have formed together a sort of small cushion (Pl. **13.** fig. 11) from which the young shoot grows up, forcing its way through the loose tissue which surrounds it (Pl. **14.** fig. 12). Other cells of the cushion grow out into hairs, and the whole has very much the appearance of an irregular cryptostoma, producing a young branch as described above. As this shoot grows out from the host-thallus, the surrounding host-cells divide actively and swell up around the base of the young plant (Pl. **13.** fig. 13). Rhizoids are given off from the base of the pseudo-cryptostoma which penetrate between the cells of the host, forming knots of irregularly shaped cells, with long thin prolongations running in all directions. In early stages these rhizoids are seen only at the base immediately below the young shoot, but later many of the cells which lie along the sides of the pseudo-cryptostoma give off rhizoids in the form of thin prolongations (Pl. **14**. fig. 14). It is only by following carefully the various stages of the junction of *Hormosira* and *Notheia* that it is possible to detect the line of demarcation between the two in a mature stage. The shoot of *Notheia* has widened exceedingly at the base, and the host has grown in proportion round it. In most cases the host-cells immediately adjoining *Notheia* have lost their colour, and it has generally been supposed that the line of demarcation corresponded with the change of colour. But this is not the case, for though the tissues of both plants are very much alike, it is possible to see, among the colourless cells, a slight irregularity which marks the line of contact of *Notheia* and its host (Pl. **14**. figs. 15 & 16). It has not been possible to determine whether the contents of the *Hormosira*-cells, immediately adjoining the *Notheia*-shoot, have lost their colour through the action of the rhizoids which have passed down between them; but the fact that age increases both the length of the rhizoids and the depth of the colourless layer of *Hormosira*-cells leads one to suspect some connection between the two. I have never seen a genuine instance of the penetration of a *Notheia*-rhizoid into one of the host-cells, though many preparations have led me to think this not improbable. It is, however, a point which can only be worked out with satisfaction on fresh material.

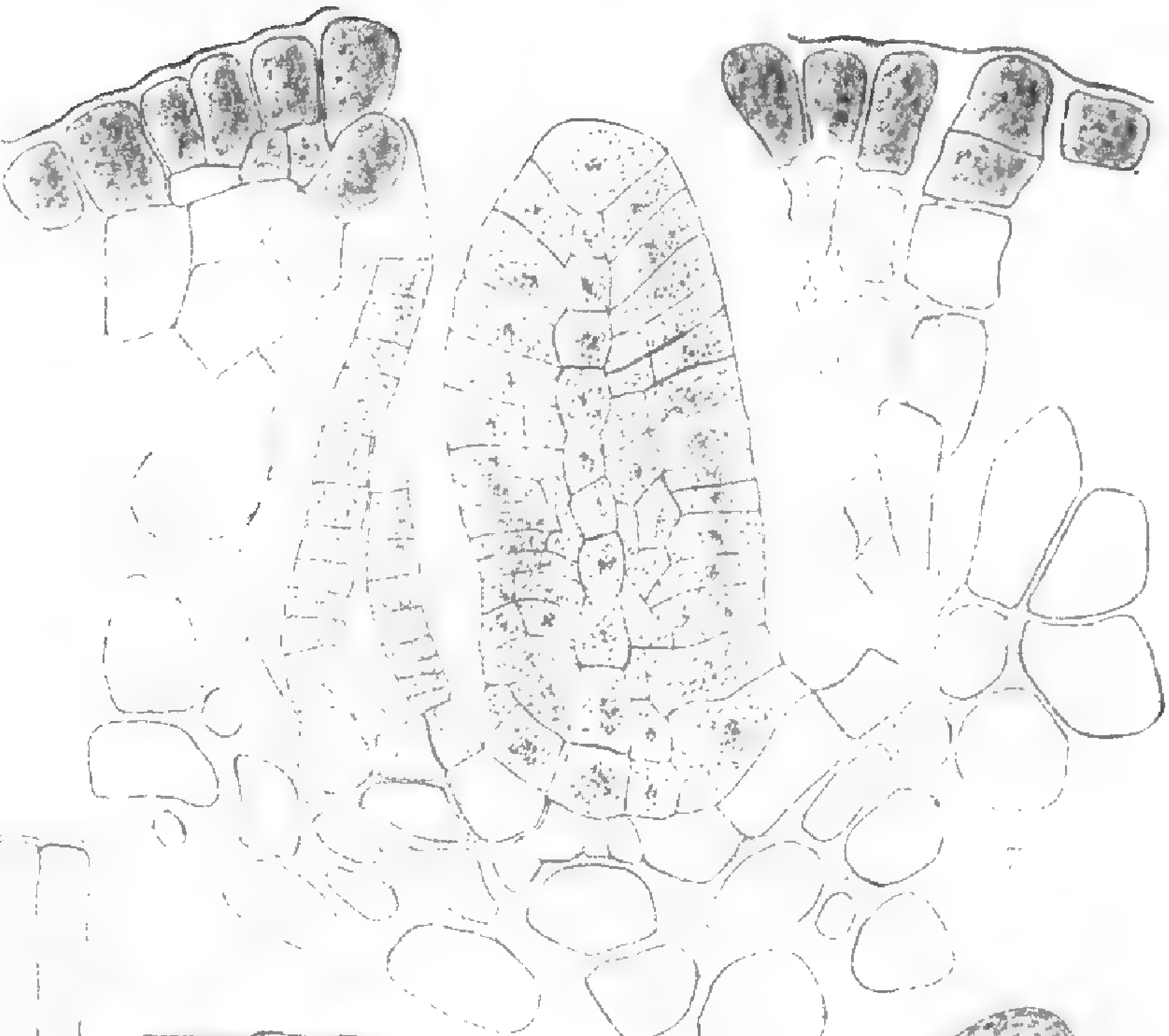
The early stages in the life-history of *N. anomala* bring to mind the figure and description of young adventitious branches from the basal disc of *Fucus vesiculosus*, as described and figured by Prof. Oltmanns (in Bibl. Bot., Heft 14, p. 73, tab. 13. figs. 10–13). Here, of course, there is nothing of a parasitic nature to be considered as in *Notheia*, but there is a certain similarity in the process of the actual growth. As the result of an injury to the thallus, a few cells within the tissue begin to divide and shortly form a small protuberance. This grows up in a radial direction through the surrounding tissue, the apical cell sinks into a depression, and the branch continues to grow in the normal fashion.

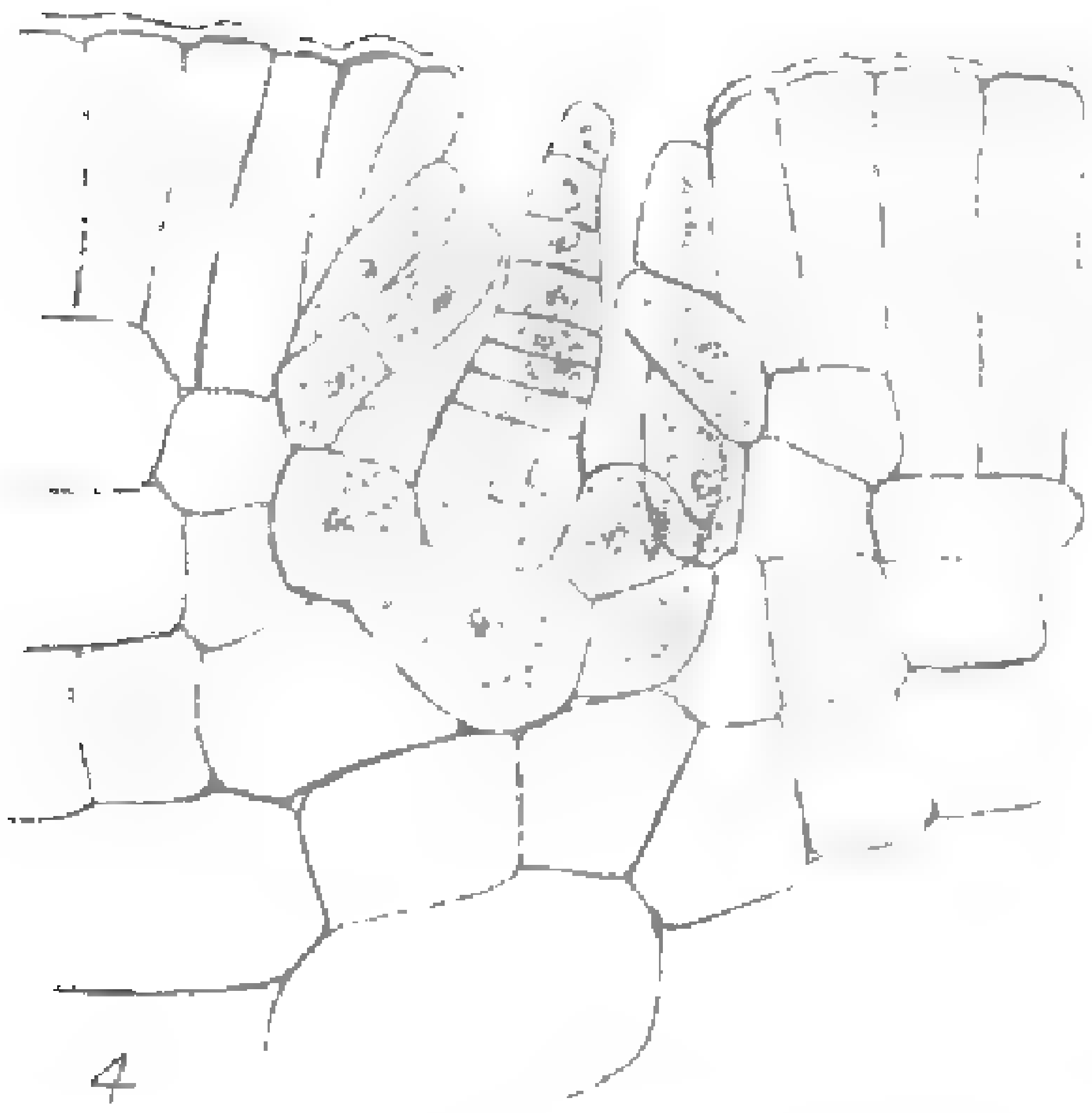
E.S.B. & P.H. del. Highley lith.

Hanhart imp.

NOTHEIA ANOMALA, *Harv. & Bail.*



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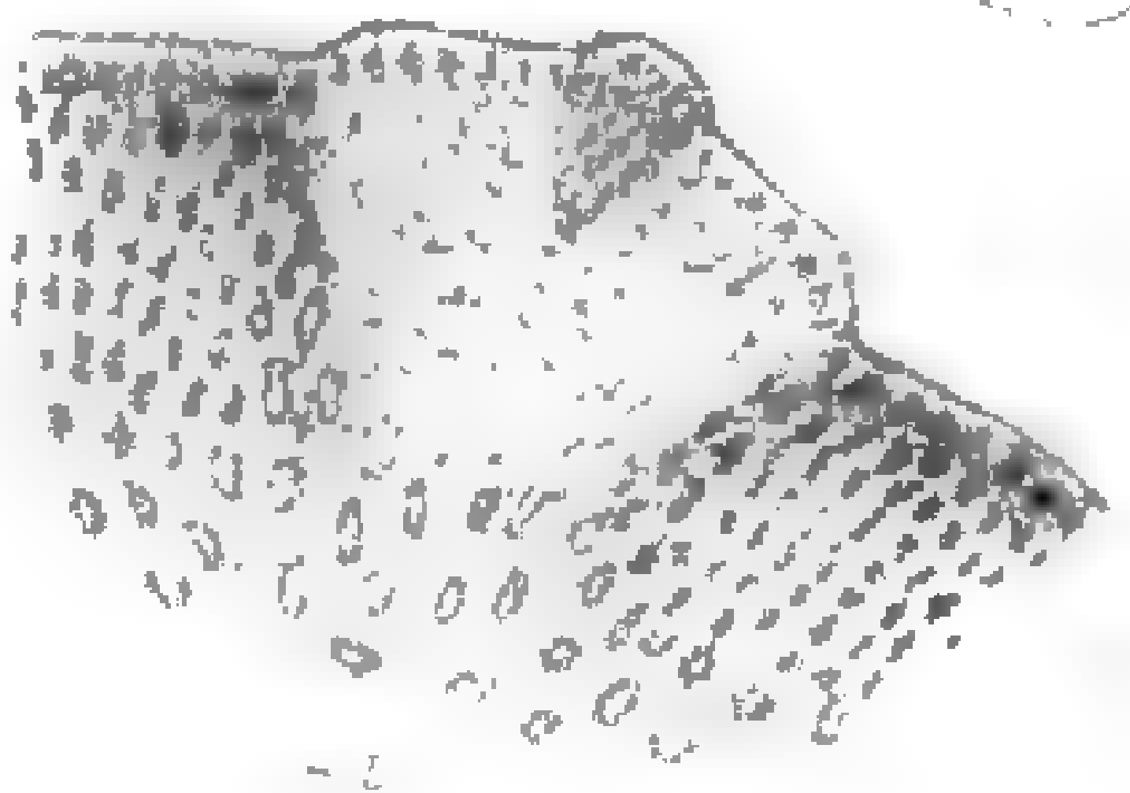
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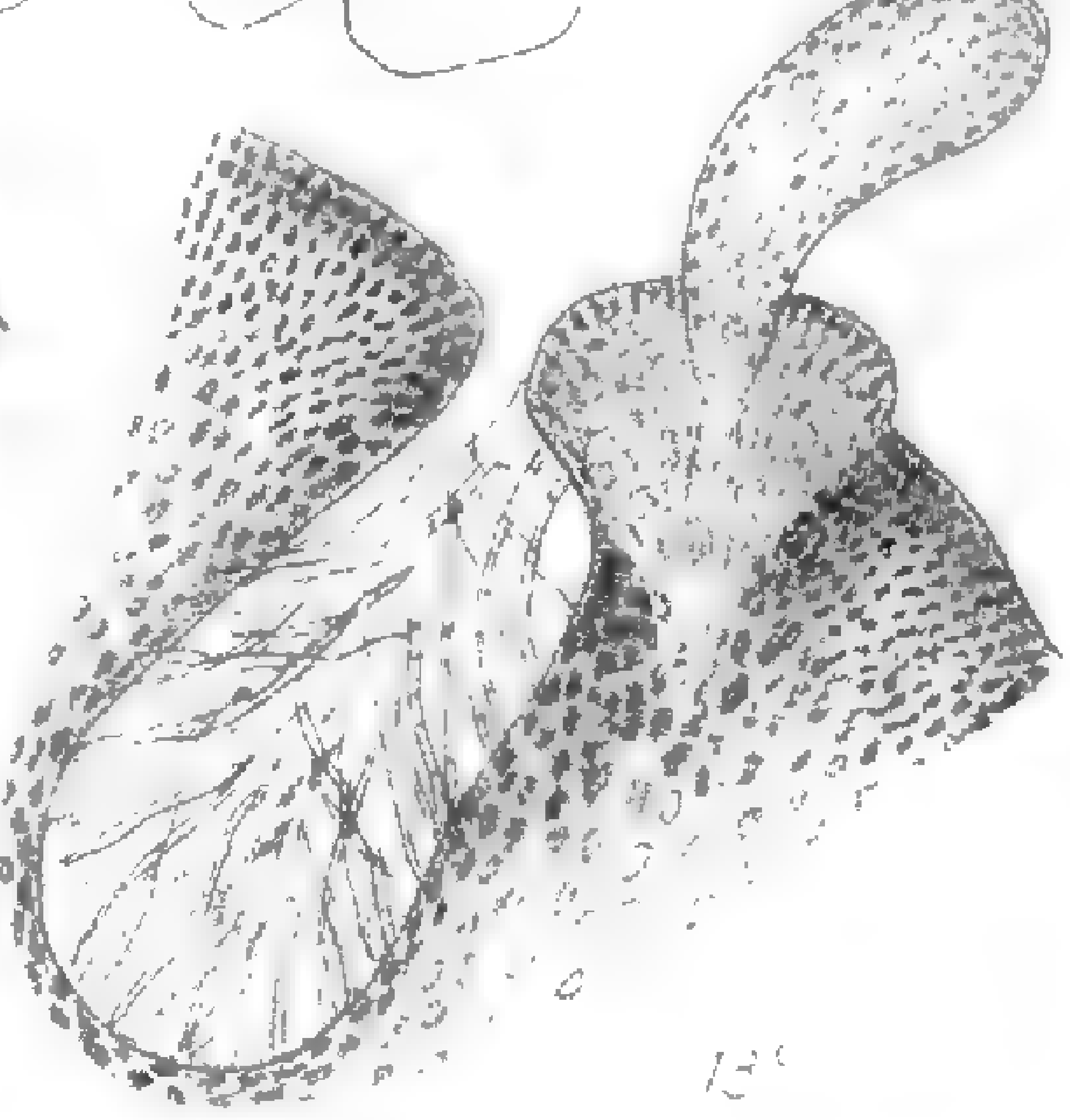
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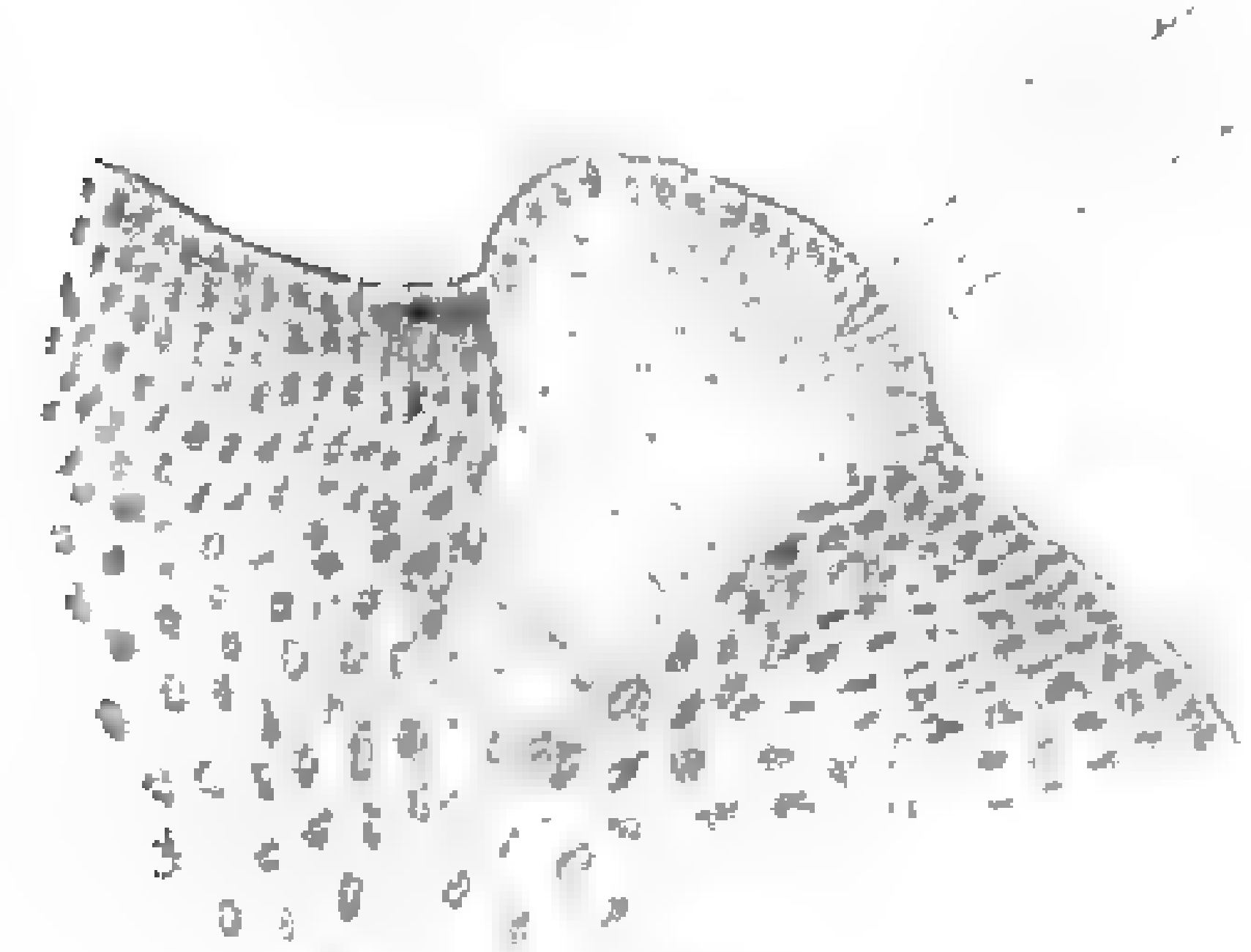
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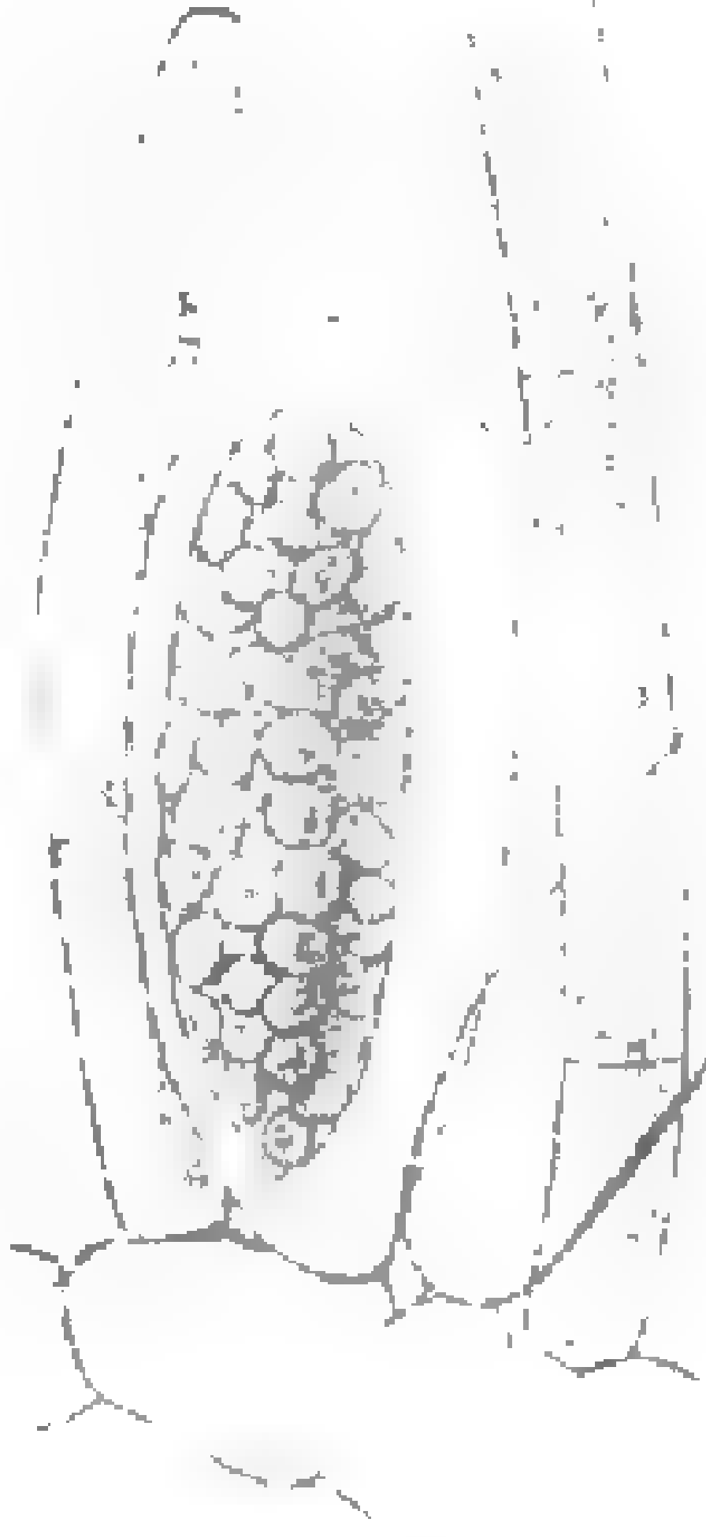
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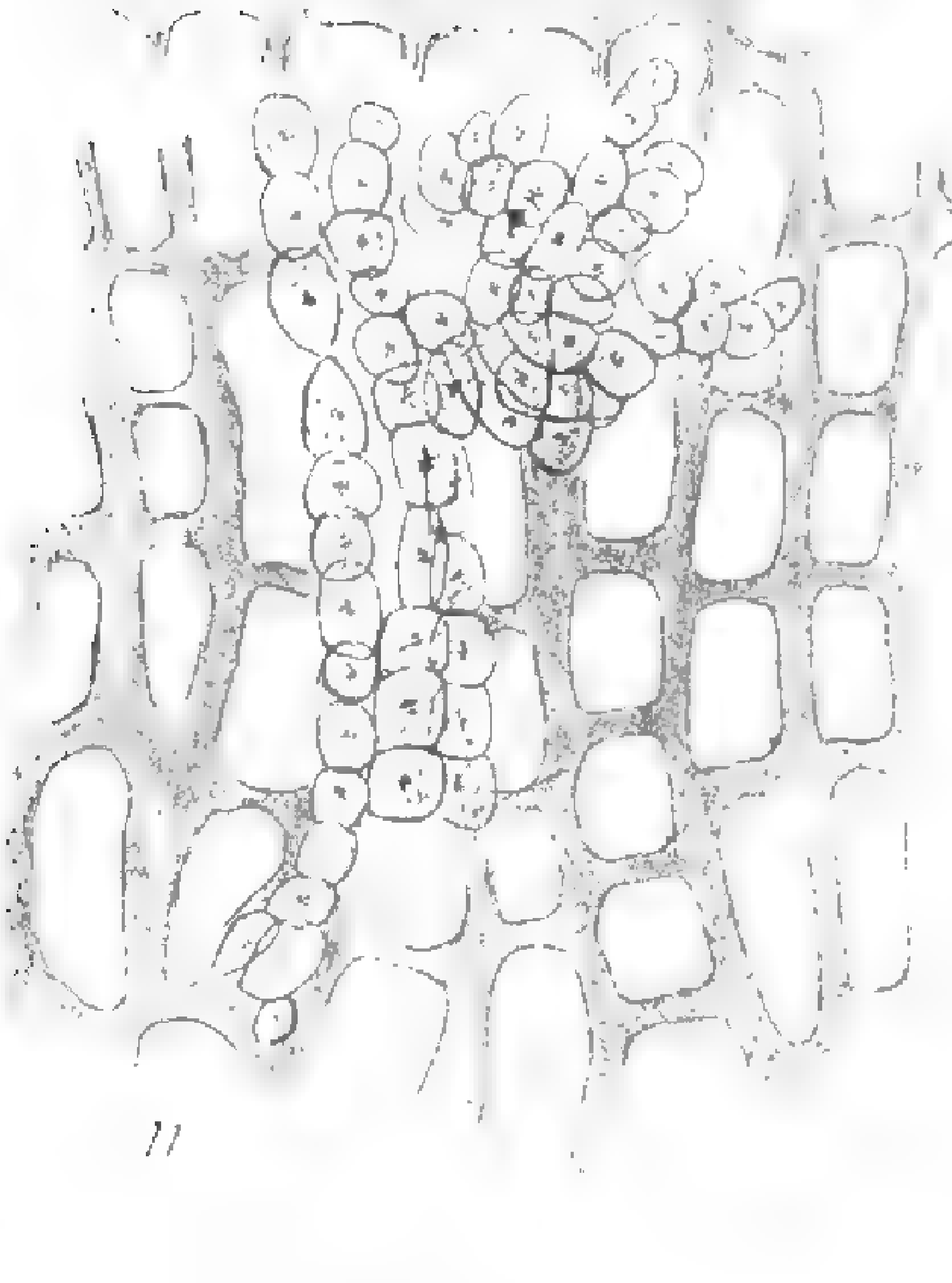
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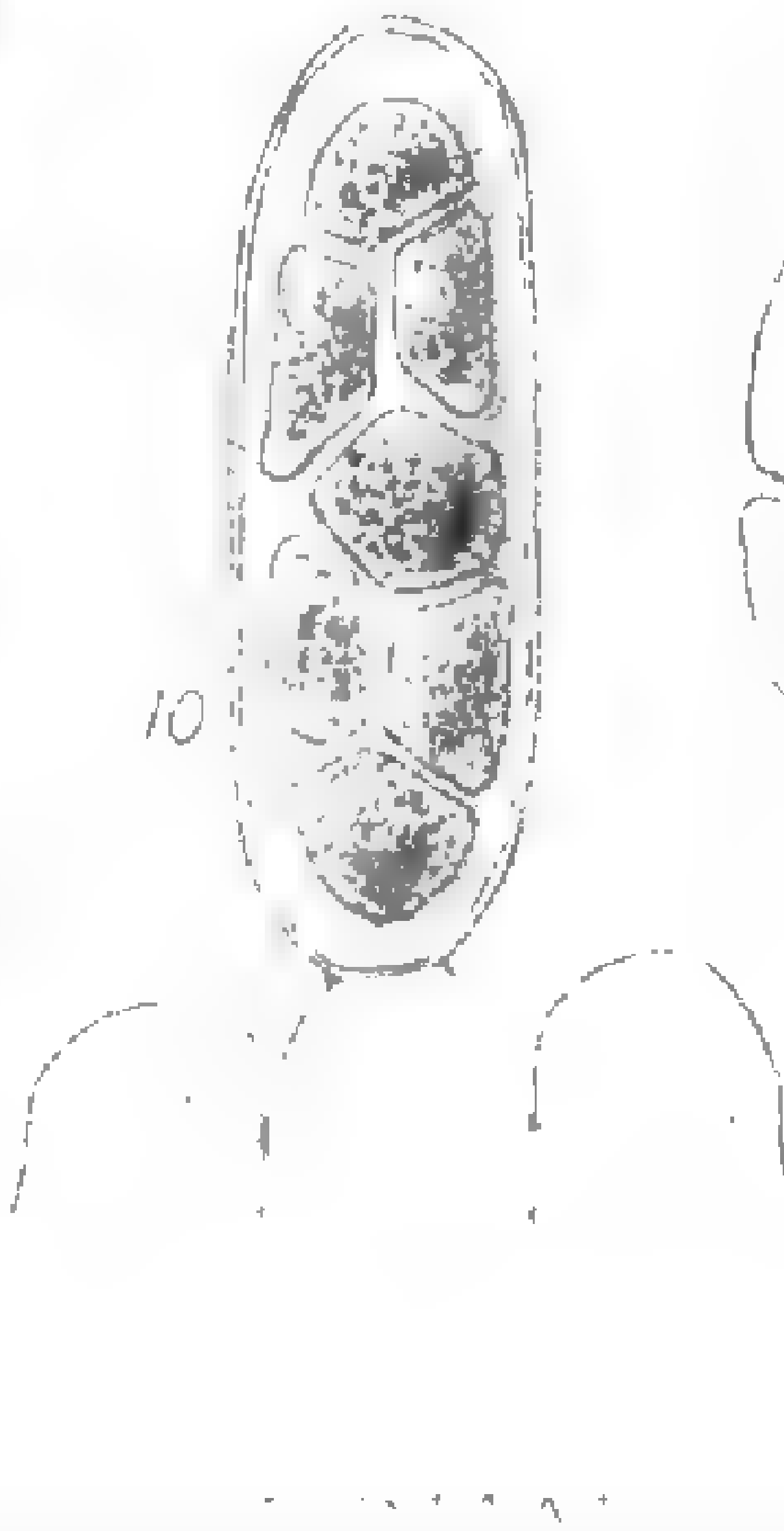
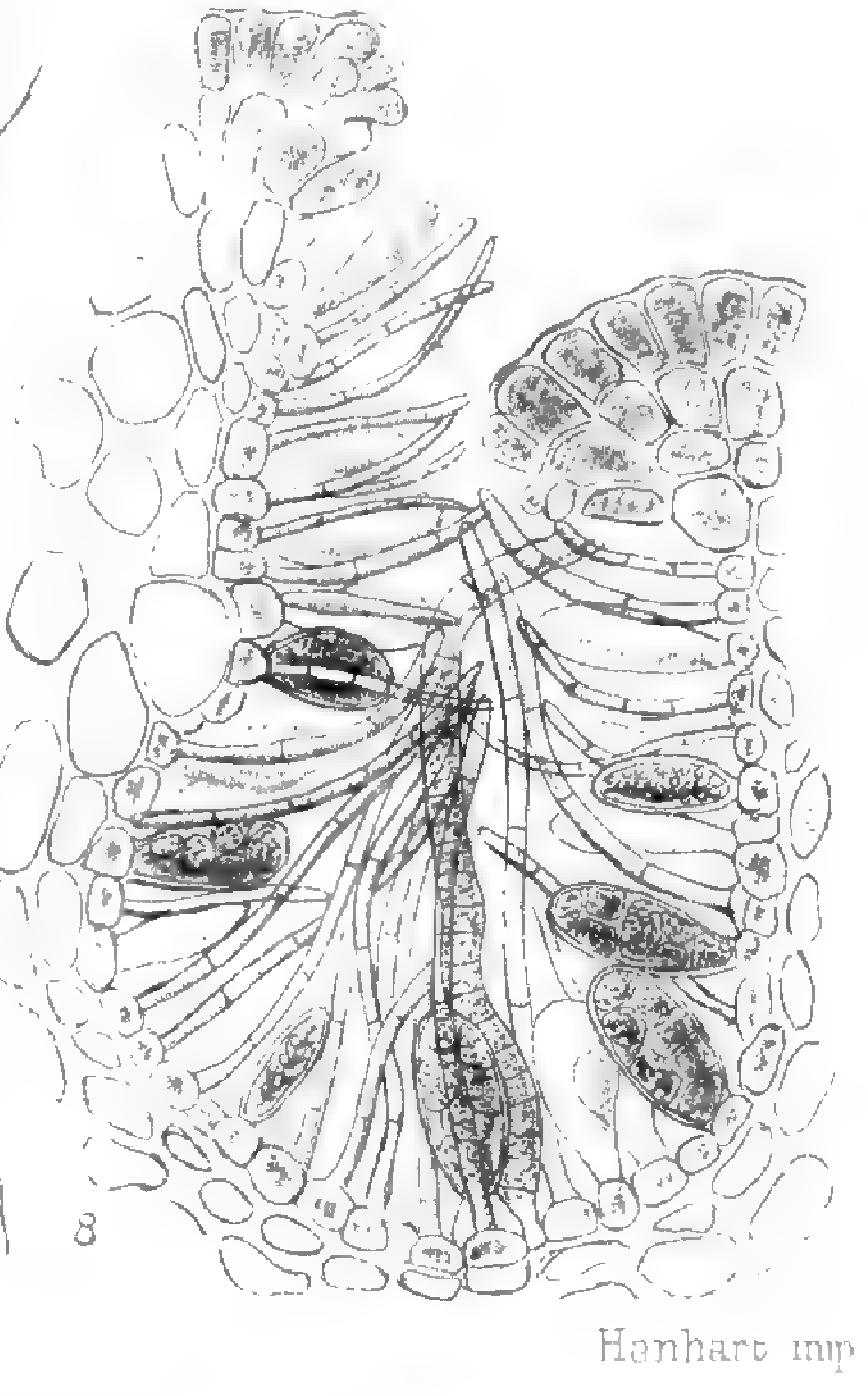
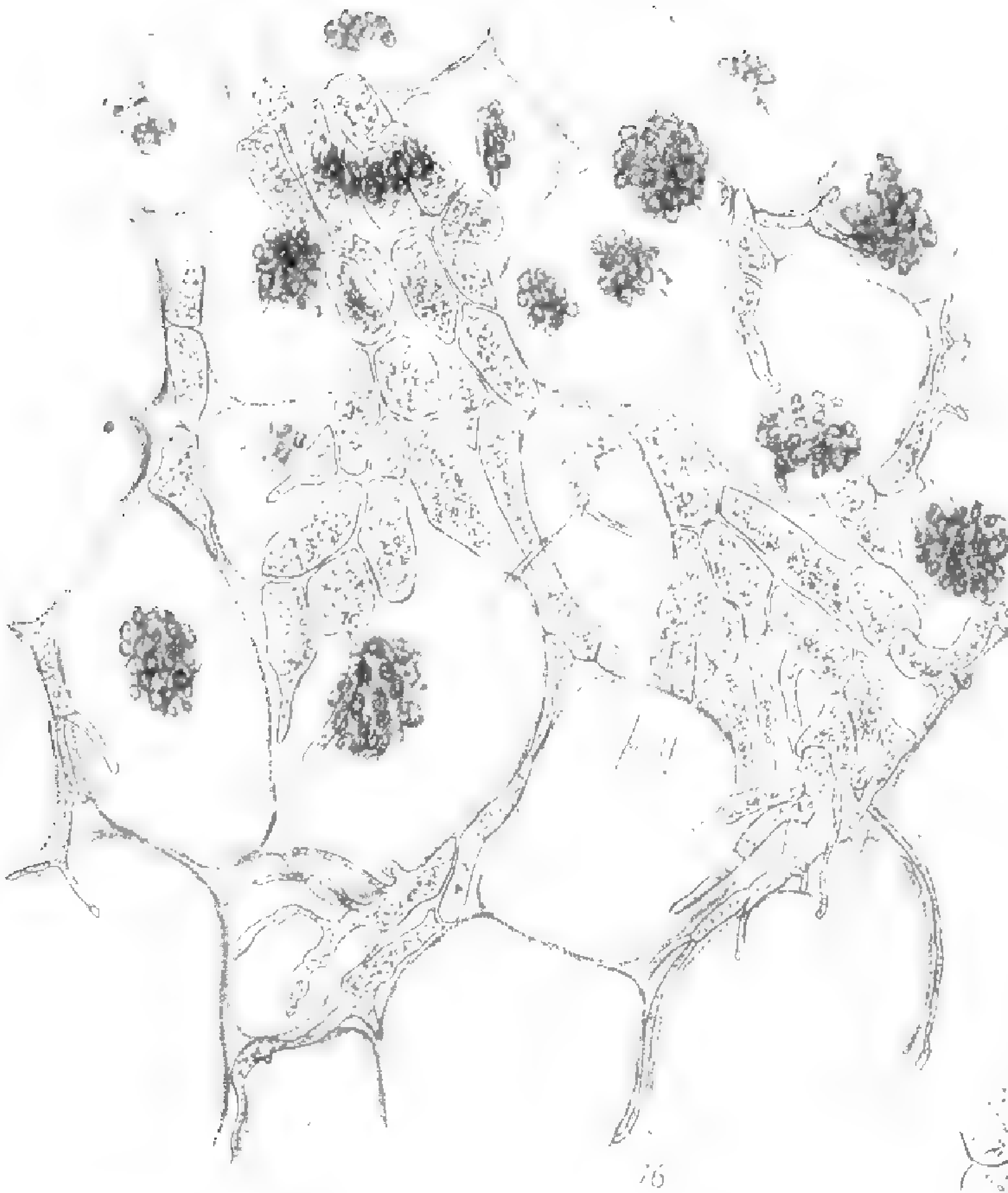




E. S. B. & P. H. del. Highley lith.

Hanhart imp.

NOTHEIA ANOMALA, Harv. & Bail.



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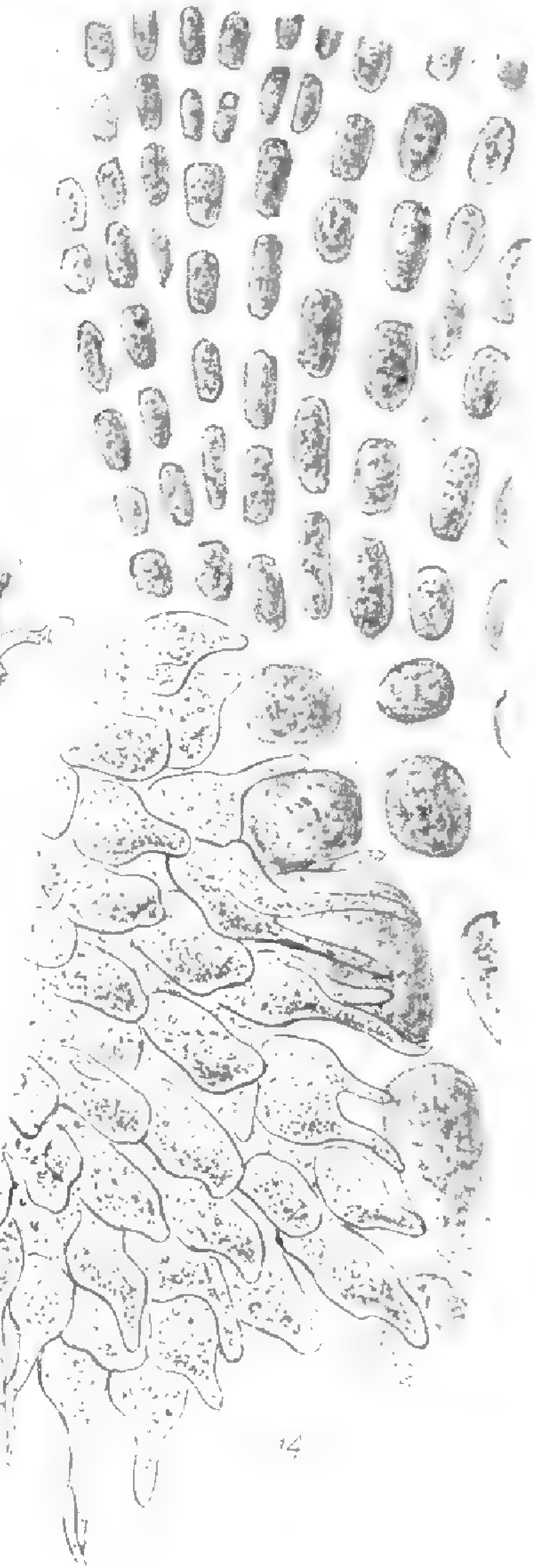

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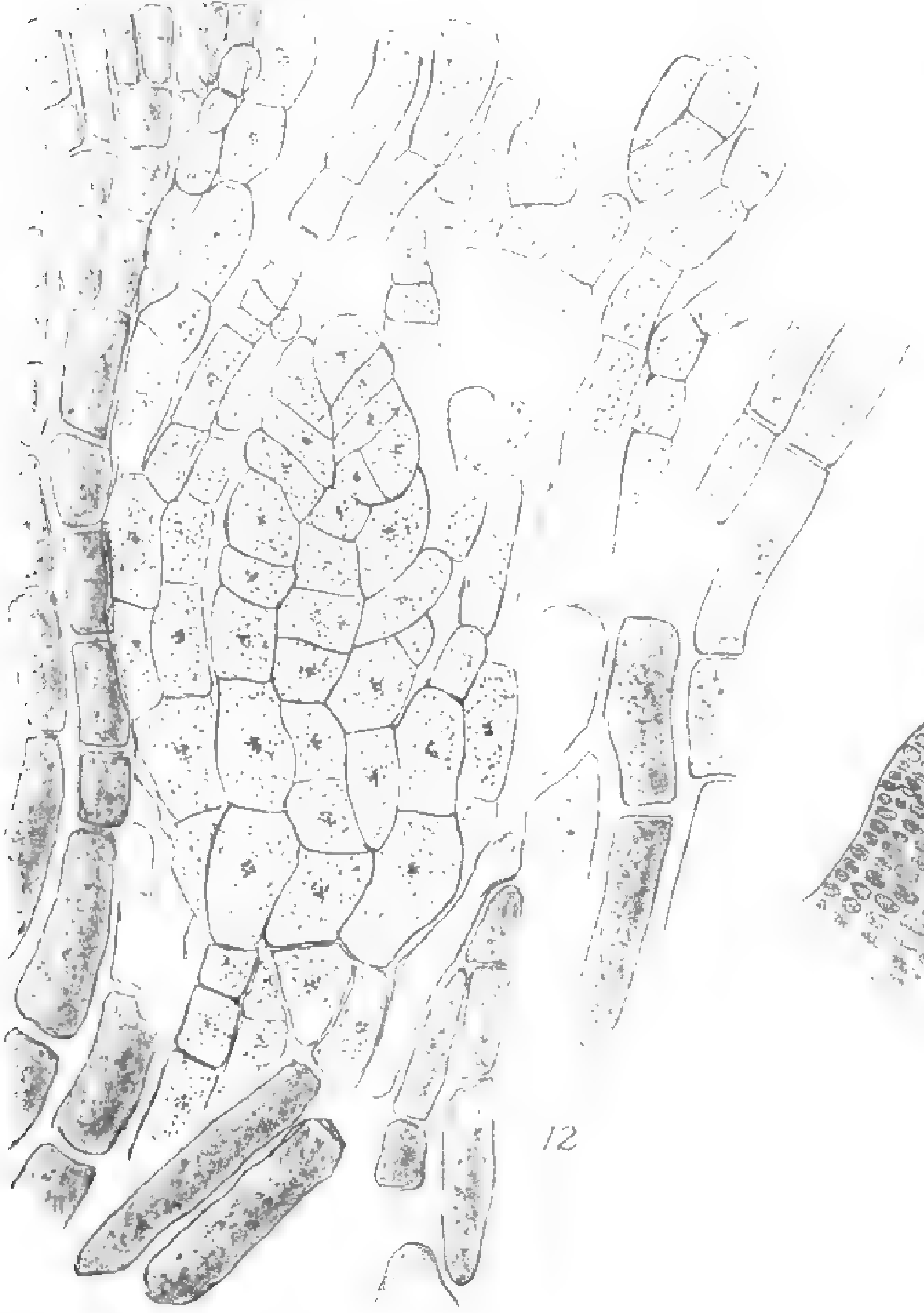

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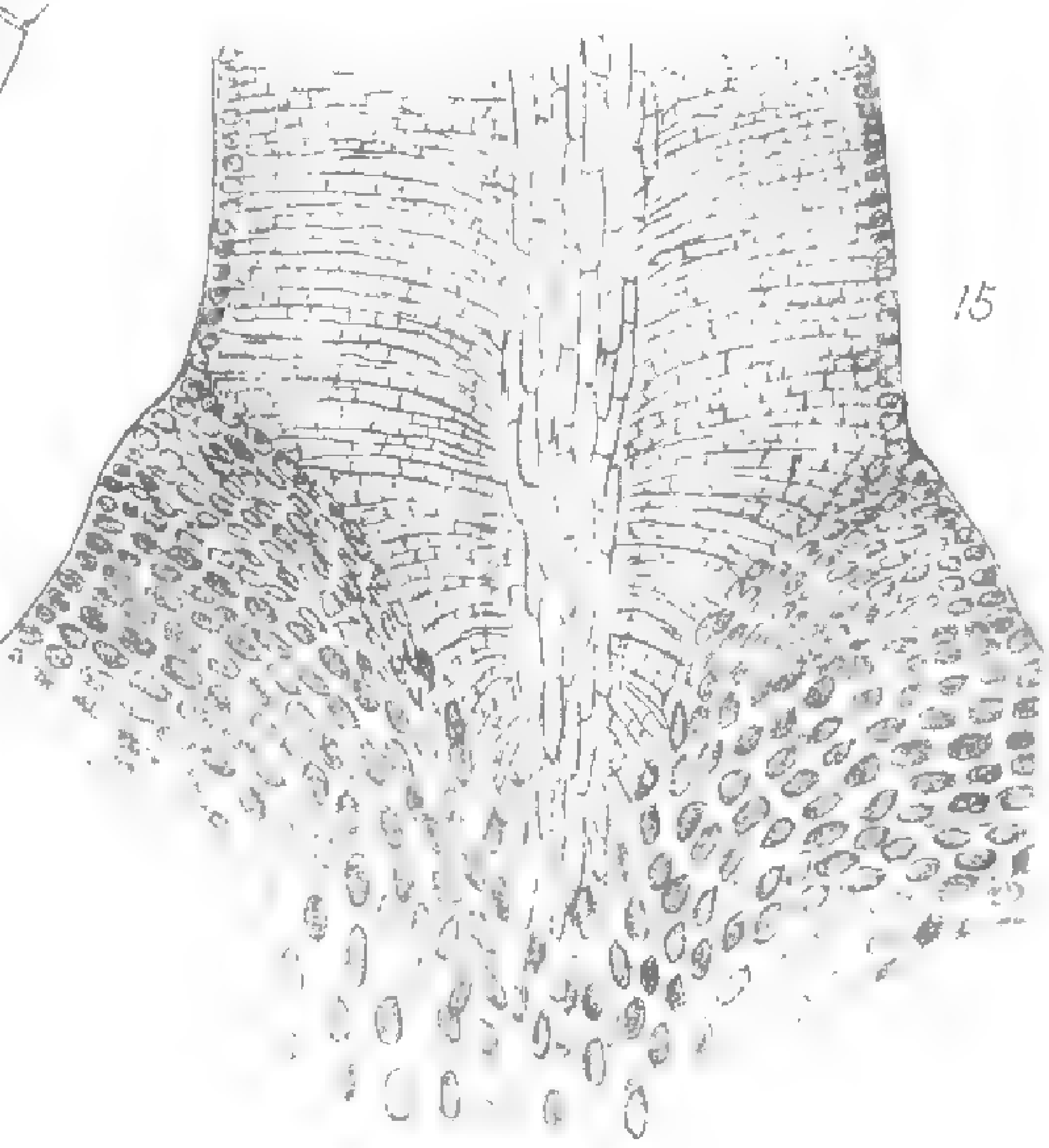

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E.S.B. & P.H. del. Highley lith.

Hanhart imp.

NOTHEIA ANOMALA, *Harv. & Bail.*

Finally, I would express my gratitude to the officials of the Botanical Department of the British Museum for their never-failing kindness and interest.

## EXPLANATION OF THE PLATES.

### PLATE 12.

Fig. 1. *Notheia anomala,* Harv. et Bail., growing on *Hormosira.* Nat. size.
  2 *a.* General view of thallus. Long. sect. × 60.
  2 *b.* Longit. section of mature thallus, showing part of central strand and intermediate layer. × 140.
  3 *a.* Transverse section of mature thallus. × 60.
  3 *b.* Cells from centre of same. × 365.
  5. Cryptostoma still more advanced. × 365.

### PLATE 13.

Fig. 4. Cryptostoma rather older. × 365.
  6. Very early stage of young branch arising from the base of a cryptostoma. × 365.
  7. Branch more advanced. × 365.
  8. Mature conceptacle, with oogonia and antheridia. × 140.
  9. Antheridium. × 365.
  10. Oogonium. × 365.
  11. Penetrating filaments of *Notheia* pushing up cuticle of *Hormosira* and forming cushion. × 365.
  13. Various stages of young plant. × 25.
    *a.* Hairs arising from cushion of *Notheia* inside host-plant.
    *b.* Young shoot which has reached the surface of the host.
    *c.* Still later stage.

The light-coloured tissue surrounding the young shoot of *Notheia* is disorganized host-tissue.

### PLATE 14.

Fig. 12. Young shoot of *Notheia* issuing from host-plant. × 365.
  14. Cells giving off rhizoids along the sides of the pseudo-cryptostoma. × 400.
  15. Junction of *Hormosira* and *Notheia.* Mature. × 65.
  16. Rhizoids of mature plant. × 400.

# *Caryophyllaceæ* of the Chinese Province of Sze-chuen.

By FREDERIC N. WILLIAMS, F.L.S.

[Read 1st June, 1899.]

THE provinces of Sze-chuen and Yun-nan form the westernmost divisions of China proper, and until somewhat recently little was known of their botany. The flora of Yun-nan has been assiduously taken in hand by M. Franchet in the course of working through the collections made by the Abbé Delavay in 1882 and following years; and he published the first instalment of the flora in 1886, after issuing a preliminary list the year before. Our knowledge of the flora of Sze-chuen is based on the distribution of a few collections of more recent date. Owing to the absence of material, the earlier parts of Mr. W. B. Hemsley's 'Index Floræ Sinensis' contain no reference to plants found to occur in Sze-chuen, and it is not till the order of Leguminosæ is reached that this province is mentioned by name, in giving the distribution of *Lespedeza juncea*. In all the orders which follow, the material afforded by such collections as came to hand was utilized with the issue of successive parts.

The following are the collections which include plants from the province of Sze-chuen, and which require to be systematically worked through in order to give any detailed account of the flora of this portion of China proper.

*Abbé Perny.* A small collection in the Paris Museum Herbarium, not critically worked out, from the mountainous region of Sze-chuen, made in 1858.

*Abbé Delavay.* Plants collected a little beyond the northern borders of Yun-nan, in 1882–1885.

*Lajos Lóczy.* A collection made by the botanist attached to Count Béla Széchenyi's expedition, organized to explore East Central Asia, and which included plants from Kan-su, Yun-nan, and Sze-chuen, collected in 1879–80, of which a descriptive list was issued by Prof. Kanitz in 1886.

*Abbé David.* Plants collected by him during his stay at Mupin, and worked through by M. Franchet in the second volume of 'Plantæ Davidianæ' (1888). This work is published as a contribution to the flora of Eastern Tibet; but Mupin and the districts explored are politically within the province of Sze-chuen.

*G. N. Potanin.* Collected plants in 1885, in Kan-su and

N. Sze-chuen. These were distributed through the Petersburg Botanic Garden to various herbaria.

*A. E. Pratt.* A collection made in 1890, chiefly in the neighbourhood of Tachien-lu, at elevations of 2700 to 4000 metres. This collection passed through Mr. Hemsley's hands, and the new species were described by him in 1892 in the Society's Journal (vol. xxix.). The list of numbers, however, was not published in the memoir.

*Prince Henry of Orleans.* A small collection (no duplicates) made in the same year, between Tachien-lu and the Tibetan frontier.

*Dr. A. Henry.* Collected in 1889 in Western Hu-peh, and the Wushan districts of Sze-chuen. The numbered specimens are constantly cited in the later parts of the 'Index Floræ Sinensis.'

*Rev. E. Faber.* Ascended Mt. Omei, an isolated elevation on the Min river, more than 3300 metres high, in 1887, and botanized it; he afterwards further explored the Yang-tze valley in Sze-chuen.

*Abbé Soulié.* The districts of Tachien-lu and Tongo-lo, and the principality of Kiala, were carefully explored by him in 1893. Part of the collection has been worked out by M. Franchet. From the character of the country traversed, the examination of further portions of the specimens will probably yield many additions to the Chinese flora.

*Abbé Piccoli.* A small collection from Shen-si and N. Sze-chuen in 1896.

The limits of the province of Sze-chuen seem to vary according to the political bias of the cartographer, and differ considerably in different maps. For the purpose of this paper, the limits are those defined in the carefully constructed map of China by Dr. Emil Bretschneider, issued in sections.

## DIANTHUS.

### Subg. *Caryophyllastrum*, sect. *Fimbriatum*.

**1. D. SUPERBUS**, *Linn.*

*Hab.* Tachien-lu (*Pratt*, n. 497, n. 535, 1890; *Soulié*, n. 262 1893).

2. **Dianthus szechuensis**, sp. nova.

Glaber, læte virens, 40 centim. Caulis subsolitarius erectus gracilis teres dichotome corymboseque ramosus. Folia basilaria pauca basi apiceque attenuata, 42–48 mm., caulina inferiora 50–75 mm., superiora 35–50 mm., omnia patentia recurva anguste linearia acuminata mollia plana 3-nervia, vagina folii diam. æquante. Flores solitarii vel binati, in paniculam laxam dichotomam dispositi, odorati. Bracteæ 4 inæquales obovatæ anguste membranaceo-alatæ juxtim purpurascentes mucronatæ adpressæ ad $\frac{1}{3}$ calycis tubum. Calyx gracilis purpurascens a basi ad apicem distincte striatus, dentibus lanceolatis subulato-acuminatis 7-nerviis post anthesin erecto-patulis. Petala rosea non contigua, fere ad faucem barbulatum multifida, area indivisa oblonga parva, ungue longe exserto quam lamina duplo longiore. Capsula cylindrica inclusa. Semina granulata.

Planta facie *D. superbi* habitu tenuior; in speciminibus autem hujus speciei, folia basilaria latiora obtusa remote 3-nervia, etiam calyx apice attenuatus brevius dentatus solum apud dentes purpureus, ejus dentibus post anthesin vix patulis.

*Hab.* Tongolo (*Soulié*, n. 69, 1893).

### Cucubalus.

3. C. **baccifer**, *Linn.*

*Hab.* N. Sze-chuen, near the borders of Kan-su (*Potanin*, 1885). E. Sze-chuen, near the borders of Hu-peh (*A. Henry*, n. 8805, 1890). W. Sze-chuen, Tachien-lu (*Pratt*, n. 405, 1890). S. Sze-chuen, Mt. Omei at 1200 metres (*Faber*, n. 152, n. 610, 1887), Mupin (*Franchet*, Pl. David. ii. p. 22 [1888],—forma foliis anguste lanceolatis longe acuminatis).

### Silene.

Subg. *Eusilene*, sect. *Dichasiosilene*.

4. S. **szechuensis**, sp. nova (ser. *Brachyanthæ*).

Perennis. Caules adscendentes, laxe et divaricatim ramosi, glabri. Folia e basi ovatâ oblongo-lanceolata attenuato-acuminata sessilia. Flores in dichasio laxo plus minus composito, centrales longe pedicellati, alares pedicello quam calyx duplo longiore suffulti. Calyx obconico-oblongus pubescens, nervis viridibus haud anastomosantibus, dentibus triangularibus acutis ciliatis. Petala emarginata, calyce paullum longiora. Capsula oblongo-globosa subsessilis, carpophoro brevissimo suffulta. Semina obtuse granulata, dorso late sulcata, faciebus depressa.

Planta *Silene Tatarinowii* et *S. rupestri* affinis, petalis ecoronatis et seminibus dorso late sulcatis atque alioqui ab ambabus diversa; etiam fere facie MELANDRYI ADENANTHI, Williams (i. e. *Silenes adenanthæ*, Franchet), speciei yunnanensis, sed capsula subsessili non vere uniloculari et petalis emarginatis gaudet.

*Hab.* Tachien-lu (*Soulié*, n. 111, 1893).

### Subg. *Eusilene*, sect. *Botryosilene*.

5. **SILENE TENUIS**, *Willd.*

*Hab.* Tachien-lu (*Pratt*, n. 551, 1890; *Soulié*, n. 101, n. 368, n. 645, 1893).

All the specimens on these four sheets can be referred to this well-marked but polymorphous species. Franchet has described a *forma rubescens* from Yun-nan, with rose-coloured petals and a more distinctly inflated calyx, but none of the above specimens seem to match no. 125 of the Abbé Delavay's plants of Yun-nan, which is the type-specimen of this form: though one or more of them recall the form described by Regel as *S. tenuis* var. *turgida*. With this exception, not previously recorded from China proper; as the south limit of the species hitherto has been given as extending to Kunawar in the Himalayas (*Jacquemont* ex *Hook. f.*, Fl. Brit. Ind. i. p. 219).

6. **S. FORTUNEI**, *Vis.*

*Hab.* Sze-chuen, near the borders of Kan-su (*G. N. Potanin*, 1885, fol. 276 in Herb. Kew).

In a recent number of the 'Botanical Magazine' (April 1899, t. 7649) there is an excellent plate of this plant (which had not previously been figured), with carefully drawn details of floral structure, from specimens which flowered in the Herbaceous Collection at Kew Gardens in September 1898. The plant was raised from seeds collected in the province of Shen-si by Father Piccoli, of the Jesuit Mission in Hankow.

## MELANDRYUM.

### Sect. *Gastrolychnis*, Rohrbach.

7. **M. SOULIEI**, sp. nova.

Caules erectiusculi pilis brevibus reflexis eglandulosis leviter vestiti, 1–3-flori. Folia inferiora lineari-lanceolata basi angustata apice acutata, superiora linearia acuta, omnia uninervia. Calyx fructifer ampliatus ovatus hirsuto-pubescens, nervis reticulato-venosis, dentibus triangularibus acutis. Petala bifida exauriculata inclusa. Capsula ovato-globosa sessilis, dentibus recurvis. Semina purpureo-fusca, dorsi sulcati margine cristato-tuberculata, faciebus depressis vel planis haud tuberculata.

Planta *Melandryo brachypetalo*, Fenzl, affinis, speciei bene definitæ quæ in regione Tibetana et in Mongolia occurrit, ab eadem nihilominus habitu valde diversa; etiam foliis angustioribus, petalis exauriculatis, et seminum structura, satis differt.

*Hab.* Tachien-lu (*Soulié*, n. 820, 1893).

8. MELANDRYUM GLANDULOSUM, *Williams.*

*Syn.* Lychnis glandulosa, *Maxim. Fl. Tangutica*, p. 83, t. 29 (1889).

Tota dense glanduloso-pilosa, 32–35 centim. Radix fusiformis simplex pleiocephala. Caulis subsimplex vel fastigiatim pauciramosus, sulcatus. Folia pleraque basi conferta, oblonga vel oblongo-linearia, infima obtusa, reliqua subacuta, radicalia in petiolum attenuata, caulina pauca sessilia, basilaria 50–80 mm., superiora 18–22 mm. Flores nutantes, longe pedicellati, ramos terminantes et ex axillis orti. Bracteæ 2 lineares uninerviæ herbaceæ. Calyx campanulatus, dentibus ovatis obtusis dense ciliatis, costis nigricanti-viridulis apice conjunctis. Petala purpurea bifida, lamina exserta in lobos oblongos divisa, ungue glabro sensim versus basin attenuato obtuse lateque biauriculato, appendicibus rotundato-obtusis fornicatis. Filamenta ciliata. Styli breves recti. Semina reniformia exalata, dorso plano seriebus 5 tuberculorum obtusorum dense papillata, disco leviter concavo.

Habitus *M. tristis*, Fenzl, quod tamen eglandulosum, flores majores, calycem distincte reticulato-nervosum, petala laminâ patente majuscula exserta, ungue subito basin versus attenuato habet, atque semina duplo majora possidet: confer etiam *M. cabulicum*, Boiss., ex Afghaniæ alpibus.

*Hab.* Tachien-lu at 2700–4000 metres (*Pratt*, n. 550, 1890).

The plant exactly agrees with Col. Przewalsky's specimens from N. Tibet (1884), and with Maximowicz's excellent plate.

### Sect. *Elisanthe*, Rohrbach.

9. **Melandryum cæspitosum**, *Williams.*

*Syn.* Silene cæspitosa, *Bur. et Franch.*, in *Journ. de Bot.* 1891, p. 22 (non *Steven*).

Acaule, cæspitosum, 4–6 centim. Folia linearia acuta, margine sparse cartilagineo-setosa, faciebus glabra. Flores solitarii; pedicelli plerumque calyce breviores, pilis brevibus dense hispidi. Calyx oblongo-clavatus purpureus basi truncatus, dentibus ovato-rhomboideis ciliolatis haud acutis, sinu inter dentes excavato-rotundato. Petala rosea longe unguiculata, lamina fere ad medium bifida, lobis linearibus parum divaricatis, ad unguem utrinsecus obtuse auriculata, appendicibus parvis binis obtusis erectis ovatis integris contiguis. Filamenta inferne pilis sparsis instructa. Ovarium ovatum, carpophoro brevissimo.

Habitus *Silenes Pumilionis*, quam quidem in memoriam revocat.

If the plant belonged to *Silene* the specific name would have to be changed, as *S. cæspitosa*, Steven, is a good species. As there is no doubt of its being a *Melandryum*, the original specific name is available with its transfer to this genus.

*Hab.* Summit of a pass, south of Batang (*Pratt*, n. 537, n. 559, 1890; *Soulié*, n. 848, 1893).

10. **M. platypetalum**, *Williams.*

*Syn.* Silene platypetala, *Bur. et Franch.*, in *Journ. de Bot.* 1891, p. 22.

Pilis brevibus conspersum. Caulis gracilis ramosus. Folia 20–26 mm., lineari-lanceolata vel linearia acutissima papillis scabrida, margine lævi anguste cartilaginea. Flores 2–3 laxe cymosi, pedicellis multum longiores; pedicelli medio bracteati villosi. Calyx obovatus basi truncatus, pilis brevibus albidis reversis vestitus, striis purpureis percursus, fructifer apice apertus, dentibus demum patentibus triangulari-lanceolatis late membranaceis obtusis, inter dentes sinu obtuse rotundato. Petala albida vel pallide rosea obcordata, lamina leviter emarginata latiore quam longa, ad unguem glabrum utrinque obtuse auriculata, appendicibus erectis contiguis obtusis oblongis. Antheræ atropurpureæ. Ovarium longe ovatum, carpophoro vix longius. Semina rubra acute tuberculata.

Characteribus plurimis hæc planta species nonnullas Americanas (*Melandryi Wrightii* et *M. Greggii*, Rohrb.) revocat, quæ floribus fructiferis omnibus erectis gaudent.

Franchet's description has been compared with Pratt's specimens. Franchet's type-specimens not seen.

*Hab.* Tachien-lu (*Pratt*, n. 530).

11. MELANDRYUM KIALENSE, sp. nova.

Pubescens, pilis densis. Caulis erectus simplex robustus quadrangulus sulcatus. Folia inferiora lanceolato-linearia ad basin angustata, superiora paullum angustiora, omnia acuta, sensim minora; bracteæ foliis supremis similes. Dichasium 9–12-florum; flores centrales arcuati. Calyx brevis basi attenuatus, breviter pubescens, evenius sed nervis superne conjunctis, dentibus triangularibus submucronato-acutis late albo-marginatis dense ciliatis statu fructifero patentibus. Petala bipartita, lobis lineari-oblongis, ungue glabro utrinque obtuse auriculato exserto, appendicibus binis obovato-rotundis brevibus distincte emarginatis. Capsula ovato-campanulata subsessilis, carpophoro 6-plo longior. Semina acute tuberculata, dorso plana vel leviter depressa, faciebus parcius tuberculatis depressa.

More pubescent than the preceding and of more robust habit, with simple stems. Differs from it further in the flowers arranged in a multifloral dichasium, with the calyx attenuate at the base, and deeply cleft petals.

*Hab.* Tongolo in the principality of Kiala (*Soulié*, n. 666, 1893).

## HEDONA.

(*Loureiro*, Fl. Cochinchin. p. 286 [1790], sed characteribus ampliatis et reformatis.)

Calyx gamophyllus, tubulosus, clavatus, turbinatus vel campanulatus, fructifer sæpe superne ampliatus, 5-dentatus, nervis 10 prominentibus æqualibus percursus, evenius vel nervis anastomosantibus. Petala 5 longe unguiculata, appendicibus basi fornicatis, unguibus ciliatis, cum staminibus carpophori stipitiformis plus minus elongati apice insistentia. Nectarium in lobos 10 divisum, ad planum laminæ reflexos. Stamina 10; filamenta filiformia; antheræ oblongæ. Styli 5, calycis dentibus oppositi. Capsula vere unilocularis, dentibus vel valvis 5 apice marginicide dehiscens, ovata. Semina plurima, tuberculata vel striolata; embryo periphericus.—Herbæ perennes, floribus speciosis in dichasia dispositis.

Genus a Loureiro bene conceptum et dilucide definitum, genere Linnæano *Coronariâ* restituto, melius pro parte prosiliente generis *Lychnidis* a Linnæo male definiti substituendum.

*Syn.* Lychnis subg. Eu-lychnis, *Pax* in *Engl. & Prantl*, Natürl. Pflanzenf. iii. Abt. I. p. 73 (1889).

12. HEDONA DAVIDI, *Williams.*

*Syn.* Lychnis Davidi, *Franch. Pl. David.* ii. p. 22 (1888).

Multicaulis, cæspitosa. Rami florentes uniflori, 4–6 centim. Folia parva 4–6 mm., ovato-lanceolata vel ovato-spathulata, margine pilis crustaceis longe ciliata. Calyx rubescens pilis crustaceis conspersis, campanulato-tubulosus evenius basi truncatus umbilicatus, dentibus ovatis rotundatis membranaceo-ciliatis. Petala biloba pallide purpurea, calyce duplo longiora, ungue calycem æquante, fauce biauriculata. Filamenta glabra. Ovarium sessile ovoideum. Capsula breviter stipitata. Semina reniformia complanata striolata anguste striolata.

Planta habitu *Silenes acaulis,* floribus majoribus et foliis brevioribus.

*Hab.* On high rocks in the Mupin district, Western Sze-chuen.

### CERASTIUM.

Subg. *Orthodon*, sect. *Cheileodontia*, ser. *Recticapsulares.*

13. C. SZECHUENSE, sp. nova.

Annuum, pilis patentibus glandulosis breviter hirsutis vestitum, viscosum, 17–22 centim. Caules simplices vel ima basi furcati. Folia sessilia lanceolata obtusa. Dichasium divaricatum multiflorum; pedicelli floriferi arcuati; pedicelli fructiferi calycem duplo superantes demum erecti; bracteæ omnino herbaceæ. Calyx umbilicatus truncatus; sepala oblongo-lanceolata subacuta, exteriora anguste scariosa, reliqua latius marginato-scariosa. Petala oblongo-cuneata breviter bidentata, calycem æquantia vel eo paullo breviora, unguibus glabris. Stamina 10; filamenta glabra. Capsula longe tubulosa stricte recta cylindrica 10-nervia calyce duplo longior. Semina pauca.

Planta *Cerastio Duriæi* affinis, speciei quæ regiones alpinas Armeniæ Turcicæ attingit, sed diversa caulibus simplicibus, pedicellis fructiferis calycem duplo superantibus, et petalis longioribus oblongo-cuneatis.

*Hab.* Tachien-lu (*Soulié*, n. 146, 1893).

14. CERASTIUM ALPINUM, var. FISCHERIANUM, *Ser.* (sp.).

*Hab.* N. part of the province (*G. N. Potanin*, 1885, ex Herb. Hort. Petropolit.).

### STELLARIA.

#### * Petiolares, *Fenzl.*

15. S. WUSHANENSIS, sp. nova.

Caules decumbenti-ramosi vel flaccide adscendentes, glabri. Folia longe petiolata ovato-cordata acuminata uninervia glabra. Flores pauci apetali alares sparsi longe pedunculati; pedunculi pilis albis transversis paucis instructi, calyce 4-plo longiores; bracteæ herbaceæ. Sepala membranacea uninervia elliptica vix acuta. Semina magna globoso-reniformia acuta tuberculata.

*Hab.* District of North Wushan (*A. Henry*, n. 7047, 1889).

16. S. MEDIA, *Vill.*

*Hab.* E. Sze-chuen (*Faber*, 1887). Mupin (*Franch.* Pl. David. ii. p. 23 [1888]).

#### ** Insignes, *Fenzl.*

17. S. NUTANS, sp. nova.

Planta 19–24 centim. Caules teretes, glabri vel parce puberuli, valde geniculati. Folia lanceolata acuta uninervia carnosula villoso-canescentia. Flores nutantes; pedicelli apicem versus reflexi; bracteæ herbaceæ. Sepala anguste lanceolata acuta. Petala bipartita, calycem æquantia. Capsula obovata.

*Hab.* Tachien-lu (*Soulié*, n. 549).

#### *** Holosteæ, *Fenzl.*

18. S. SOULIEI, sp. nova.

Perennis, glabra, 23–26 centim. Caules ramosi, superne repetite cymosi. Folia uninervia acuminata, margine villosa. Flores alares et terminales; alares sparsi, terminales dichotomo-cymosi; bracteæ scariosæ. Flores longe pedicellati; pedicelli flore 3–4-plo longiores. Sepala anguste lanceolata acuminata trinervia margine scariosa. Petala bipartita, calyce subbreviora. Capsula breviter obovata.

*Hab.* Tachien-lu (*Soulié*, n. 914, n. 971).

19. S. HENRYI, sp. nova.

Glabra. Caules procumbentes, 16–18 centim., tenues. Folia anguste lineari-lanceolata uninervia acuta. Flores solitarii; pedicelli unifariam glanduloso-pubescentes. Sepala anguste lanceolata acuminata glandulosa, pilis sparsis hispidis purpureis instructa. Petala biloba unguiculata, calyce 1½-plo longiora. Capsula ovoideo-globosa.

Distinguished from allied species by the scattered stiff purple hairs which invest the calyx.

*Hab.* S. Sze-chuen (*A. Henry*, n. 6970, 1889).

**** Larbreæ, *Fenzl.*

20. STELLARIA DICHASIOIDES, sp. nova.

Glabra. Caules teretes. Folia subovali-lanceolata acuta uninervia. Flores nutantes in dichotomiis iteratis. Sepala anguste lanceolata acuminata tomentosa anguste scariosa. Petala bipartita calycem æquantia. Semina mamillata.

*Hab.* Tachien-lu (*Soulié*, n. 216, 1893).

21. S. ULIGINOSA, *Murray*.

(*Rev. E. Faber*, n. 337, 1887.) The specimens agree with those of typical *S. uliginosa*, which, according to Franchet, is found in the neighbouring province of Yun-nan (*Delavay*, n. 1127).

22. S. UDA, sp. nova.

Cæspitosa, viridis, glabra. Caules filiformes fragiles debiles. Folia anguste lineari-lanceolata acuminata uninervia, non succulenta. Flores longe pedicellati; pedicelli foliis superioribus 3–4-plo longiores. Sepala lanceolata acuminata 3-nervia anguste scariosa. Petala bipartita calycis ⅓ breviora. Capsula obovato-globosa. Semina mamillata.

Near *S. uliginosa*, but bracts foliaceous.

*Hab.* Tachien-lu (*Soulié*, n. 913, 1893).

KRASCHENINNIKOVIA.

23. K. DAVIDI, *Franch. Pl. David.* i. p. 51, t. 10 (1884).

*Syn.* Stellaria Davidi, *Hemsl. Ind. Fl. Sinens.* in *Journ. Linn. Soc.* xxiii. p. 67 (1886).

*Hab.* S. Wushan (*A. Henry*, 1889).

The genus was re-established by Maximowicz, and its characters were more clearly defined. As defined originally by

Turczaninow (1838), from the characters given, one would scarcely be justified in maintaining it as a genus distinct from *Stellaria.* Maximowicz, however, in a careful study of a series of specimens of *Krascheninnikovia rupestris*, indicates other characters, such as the diverse type of the structure of the flowers found at the base of the stem in contact with the soil, as compared with those terminating the flowering stems. And on the characters brought together by Maximowicz its separation from *Stellaria* is certainly warranted. The plant described as *Stellaria bulbosa*, Wulf., in the 'Flora of British India' is certainly to be referred to *K. Davidi* (and is a form of it), which is recorded by Franchet from the neighbouring province of Yun-nan (*Delavay*, n. 1035, 1884). Mr. Hemsley records the species elsewhere in China only from Jehol, in the province of Chih-li (*David*, n. 1924). Franchet also forbears to separate the genus from *Stellaria*, as he says:—" L'ancien genre *Krascheninnikovia* est aujourd'hui rapporté aux *Stellaria* par presque tous les auteurs, bien qu'il ne soit pas moins nettement caracterisé que la plupart des autres genres de Caryophyllacées, maintenus plutôt par habitude qu'en raison d'une valeur réelle."

### ARENARIA.

#### Subg. *Euarenaria.*

24. A. NAPULIGERA, *Franch.*
*Hab.* Tachien-lu (*Pratt*, 1890).

25. A. SERPYLLIFOLIA, *Linn.*
*Hab.* Yang-tze valley (*Rev. E. Faber*, n. 336, 1887). District of Mupin (ex *Franch.* Pl. David. ii. p. 23 [1888]).

#### Subg. *Eremogoneastrum.*

26. A. KANSUENSIS, *Maxim.*
*Hab.* N. Sze-chuen (*Potanin*, 1885); Tachien-lu (*Pratt*, n. 617, 1890).

27. A. POLYTRICHOIDES, *Edgew.*
*Hab.* Batang on the river Di-chu, and east of Tachien-lu (*Lóczy* n. 227, ex Kanitz, Bot. Centr. Asiatic. Exped. Széchenyi, in Math. Naturwissensch. Ber. Ung. iii. [1886]).

Subg. *Odontostemma.*

28. ARENARIA YUNNANENSIS, *Franch.*
*Hab.* Tachien-lu (*Pratt*, n. 155, 1890).

29. A. DELAVAYI, *Franch.*
*Hab.* Tachien-lu (*Pratt*, n. 561, 1890).

30. A. QUADRIDENTATA, *Williams*, in *Journ. Linn. Soc., Bot.* xxxiii. p. 432 (1898).

*Hab.* N. Sze-chuen (ex *Maxim. Fl. Tangutica*, p. 84 [1889], "Lepyrodiclis quadridentata").

Subg. *Macrogyne.*

31. A. SZECHUENSIS, sp. nova.

Plantula 30–45 mm. alta, vix supra humum, nana diffusa multiflora glanduloso-pubescens. Cauliculi tenues. Folia 7–12 mm., linearia obtusa, basi dilatata, laxe connata, parce ciliolata. Pedicelli axillares et terminales. Calyx basi truncatus; sepala 2½–4 mm., dense glandulosa, lanceolata acuta, margine anguste scariosa. Petala calyce 2½-plo longiora, alba ovalia breviter unguiculata. Styli subulati, calycem longe superantes.

Differs from *A. longistyla* in the more diffuse multifloral stems producing both axillary and terminal flowers, in the small sepals acute instead of mucronate at the apex, and the large oval petals. It is not very different from *A. linearifolia*, Franch., from which it is distinguished by the leaves; though the latter is stated to have winged seeds, and should thus be transferred to *Moehringia*, for which therefore I propose the name of M. LINEARIFOLIA.

*Hab.* Tachien-lu (*Soulié*, n. 814, 1893).

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The new regulations in regard to publications in the Journal are as follow:—

Papers read from November and before the middle of January are published on **1st April.**

Papers read after the middle of January and before the end of April are published on **1st July.**

Papers read in May and June are published on **1st November.**

# NOTICE.

Vol. XXVI. is still in course of issue, and the Parts already published are as follows:—

Vol. XXVI., Nos. 173–178.

[Nos. 179–180 are reserved for the conclusion of Messrs. Forbes and Hemsley's 'Index Floræ Sinensis,' of which No. 179 will be issued shortly.]

Vol. XXVII., Nos. 181–188. (Complete.)

Vol. XXVIII., Nos. 189–196. (Complete.)

Vol. XXIX., Nos. 197–204. (Complete.)

Vol. XXX., Nos. 205–211. (Complete.)

Vol. XXXI., Nos. 212–219. (Complete.)

Vol. XXXII., Nos. 220–227. (Complete.)

Vol. XXXIII., Nos. 228–234. (Complete.)

Vol. XXXIV., Nos. 235–239.

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# THE JOURNAL

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Subg. *Odontostemma.*

28. Arenaria yunnanensis, *Franch.*

*Hab.* Tachien-lu (*Pratt*, n. 155, 1890).

29. A. Delavayi, *Franch.*

*Hab.* Tachien-lu (*Pratt*, n. 561, 1890).

30. A. quadridentata, *Williams*, in *Journ. Linn. Soc., Bot.* xxxiii. p. 432 (1898).

*Hab.* N. Sze-chuen (ex *Maxim. Fl. Tangutica*, p. 84 [1889], "Lepyrodiclis quadridentata").

Subg. *Macrogyne.*

31. A. szechuensis, sp. nova.

Plantula 30–45 mm. alta, vix supra humum, nana diffusa multiflora glanduloso-pubescens. Cauliculi tenues. Folia 7–12 mm., linearia obtusa, basi dilatata, laxe connata, parce ciliolata. Pedicelli axillares et terminales. Calyx basi truncatus; sepala 2½–4 mm., dense glandulosa, lanceolata acuta, margine angusta scariosa. Petala calyce 2½-plo longiora, alba ovalia breviter unguiculata. Styli subulati, calycem longe superantes.

Differs from *A. longistyla* in the more diffuse multifloral stems producing both axillary and terminal flowers, in the small sepals acute instead of mucronate at the apex, and the large oval petals. It is not very different from *A. linearifolia*, Franch., from which it is distinguished by the leaves; though the latter is stated to have winged seeds, and should thus be transferred to *Moehringia*, for which therefore I propose the name of M. linearifolia.

*Hab.* Tachien-lu (*Soulié*, n. 814, 1893).

# On the Origin of the Basidiomycetes.

## By GEORGE MASSEE, F.L.S.

[Read 18th January, 1900.]

(PLATES **15** & **16**.)

THE recent extensive researches by Brefeld (1) have thrown much light on the morphology and affinities of the group of fungi known as the Basidiomycetes, and even those who cannot accept his interpretation as to affinities in its entirety, are doubtless ready to admit that, due in a large measure to his investigations and deductions therefrom, we possess at the present day a clearer and truer conception of the general development or evolution of the group of fungi under consideration than heretofore.

As is well known, the gradual differentiation of the specialized portions of hyphæ or basidia immediately bearing conidia, are considered by Brefeld as constituting the one essential factor in indicating true affinity and descent in the Basidiomycetes. Hence in the Protobasidiomycetes, characterized by having basidia divided into two to four superposed cells by transverse septa, each cell producing a conidium, Brefeld sees a counterpart in the promycelium or the fertile hyphæ produced directly on spore germination in the Ustilagineæ, and inclines to the view that the Protobasidiomycetes may be derived from the Ustilagineæ through the Uredineæ, Auriculariæ, and Pilacreæ, when the transversely septate basidium is replaced by a vertically divided basidium in Tremelleæ and Dacryomycetæ; a transition group, leading to the Autobasidiomycetes, including the Gastromycetæ, Phalloideæ, and Hymenomycetæ, characterized by basidia consisting of a single cell—neither transversely nor vertically septate—and bearing the spores at or near the apex, and usually definite in number.

The existence of septate basidia, however, is not an entirely recent discovery; those of *Pilacre Petersii*, Berk. & Broome, and *Hypochnus purpureus*, Tul., having been correctly described and beautifully figured by Tulasne (2) twenty-seven years ago. In fact the basidia of the last-named species were first described by Tulasne (3) thirty-four years ago, the description being followed by the paragraph quoted below—the first time we believe since its publication—the substance of which is considered by most mycologists as being a much later conception. "Palmam, qui meruit, ferat."

Tulasne says:—"On sera certainement frappé comme nous de la ressemblance singulière qu'offrent les crosses fertiles de l'*Hypochnus purpureus* avec le *promycelium* des Puccinies et autres Urédinées, c'est à dire avec ces germes d'abord claviformes, puis circinants et spiculifères, dont nous avons autrefois donné des figures dans ce Recueil (sér. 4$^e$, t. ii. pls. 7–12). La similitude n'est même pas moindre pour les corps réproducteurs, spores ou sporidies, et nous trouvons certainement là un example des analogies qui peuvent relier deux membres, d'ailleurs très-dissemblables, d'une même famille végétale" (**3**. 296).

Quite recently Juel, a Swedish botanist, has demonstrated that the somewhat widely diffused, and not by any means uncommon fungus called *Stilbum vulgare*, Tode, the type of the large genus *Stilbum*, Tode, located in the Hyphomycetes, is indeed a typical Protobasidiomycete, having the characteristic transversely septate basidia, each segment of the basidium producing a single basidiospore (**4**).

The segmentation of the basidium is preceded by nuclear division, each segment containing a single nucleus which again divides, one nucleus passing into the spore, the other remaining in the basidium (Pl. **15**. figs. 2–6).

Juel examined other species belonging to *Stilbum*, and found that they did not present the Protobasidiomycete features found in *S. vulgare*; and suggests that the generic name *Stilbum* should be retained for those members proved to belong to the Protobasidiomycetes, and that another genus should be established for those members of the old genus which, on account of their structure, have yet to be considered as belonging to the Hyphomycetes.

The genus *Stilbum*, as originally understood, contains about seventy species; all are minute, and the general structure may be compared to that of a sheaf of corn. The hyphæ are arranged in a parallel fascicle, the free tips bearing the conidia spreading on all sides, and forming a more or less globose fertile head, terminating an elongated slender stem, the whole resembling a drumstick in miniature. Every part is compact and firm, the component hyphæ being to some extent cemented together by mucilage.

*Tubercularia*, Tode, another genus included in the Hyphomycetes, is morphologically indistinguishable in all essential features from *Stilbum*, but separated by systematists on account of the shorter stem, the subglobose head being nearly, or in many species quite, sessile on the matrix, as in the well-known *Tubercularia vulgaris*, Tode, which forms coral-red pustules on decaying or dead branches.

*Tubercularia* includes about seventy species, several of which are the conidial condition of ascigerous fungi belonging to the genus *Nectria*.

About thirty members of the long-stemmed or *Stilbum*-forms are also known to represent the conidial condition of species of *Nectria* or *Sphærostilbe*, the name given by Tulasne to those species of the old genus *Nectria* having 1-septate spores and a *Stilbum* as the conidial form of reproduction (**5**).

In many instances the genetic relation between a conidial condition and its higher form of fruit is not distinctly proved; the researches of Tulasne (**6**), Hartig (**7**), and others, however, leave no doubt as to the relationship between *Stilbum* or *Tubercularia* and species of *Nectria*.

The general structure is alike in all known instances. A compact parenchymatous base or stroma forms in the substance of the matrix, and eventually projects above its surface as a cushion-like body; from the superficial cells of this stroma the fertile hyphæ—conidiophores or basidia—of the *Tubercularia* or *Stilbum* originate. At a later date the primordia of the ascigerous or *Nectria*-form of reproduction appear in the peripheral portion of the stroma; these gradually develop into the characteristic red perithecia which stud the surface of the stroma in *Nectria* proper, the conidial phase being obliterated by the later development of the perithecia; whereas in *Sphærostilbe* the long-stemmed *Stilbum*-condition and the ascigerous perithecia are both present at the same time (Pl. **15**. fig. 7).

A second, and even third conidial form of reproduction, also produced by the stroma, is present in some species of *Nectria*, but appear to have no bearing on the subject under consideration.

In addition to those form-species of *Tubercularia* and *Stilbum* known for certainty to represent the conidial condition of species of *Nectria* or *Sphærostilbe*, many species belonging to each of these genera exist that have not up to the present been correlated with any higher form of fruit, and in many instances it would appear that such must be considered as entities or species; the facts in favour of such an argument being the power to reproduce themselves apparently indefinitely, and the absence of proof as to the existence of any other phase of reproduction in their life-cycle.

Assuming this statement to prove correct, it suggests the following problem :—

How long must a conidial form continue to reproduce itself after the disappearance of its higher phase in the cycle of development, before it can be considered as a species in the ordinary acceptance of that term?

If taken to task as to the evidence of a second phase having existed at any previous period in the life-history of such organisms, it may be stated that presumable evidence is forthcoming, not only in the genera *Stilbum* and *Tubercularia,* but in numerous other instances where a conidial or simple phase has, from analogy, lost for all time the higher stage of fruit it once possessed.

The evidence obtainable in the genera under consideration consists in the presence, in several instances, of a more or less well-developed stroma, which, however, only produces conidia, whereas, following the sequence of gradual disappearance of the stroma, we come to species where this primordial structure has entirely disappeared.

In the form-genus *Botrytis,* we have a similar decadence of the stroma or sclerotium, which in some species produces the ascigerous condition only, in others the ascigerous or conidial condition, depending on external conditions, in others again giving origin to conidia only; whereas in a host of other species the stroma is quite rudimentary or entirely absent, the conidial condition alone remaining.

It is in the Uredineæ, however, that we encounter the clearest evidence of the gradual disappearance of one or other of the forms originally included in the life-cycle of the various species.

After the announcement of Juel's discovery, I examined numerous species of *Stilbum* and *Tubercularia,* for the purpose of ascertaining whether some other members might not prove on careful examination also to belong to the Protobasidiomycetes.

Among those examined was the *Stilbum*-condition of *Sphærostilbe microspora,* Cooke & Massee; and here I was much surprised to find that the structure of the fertile tips of the hyphæ agreed in every detail with those of *Stilbum vulgare*, as described and figured by Juel. It was clearly evident that if the one was a Protobasidiomycete, the other must necessarily be one also (Pl. **15**. figs. 10–12).

Furthermore, this discovery revealed the somewhat unexpected fact that the conidial condition of an ascigerous fungus was itself a typical member of the Protobasidiomycetes.

*Tubercularia volutella*, Corda, is also a true Protobasidiomycete, having distinctly clavate, transversely septate basidia, each septum bearing a single spore (Pl. **16**. fig. 16).

As stated by Juel, I found that many species of *Stilbum* and *Tubercularia* possessed basidia or spore-bearing hyphæ differing in structure from those of *Stilbum vulgare*, and indicating at first sight the possibility of belonging to a distinct genus, as suggested by Juel. However, after having examined over one hundred species included in the two genera, it was clearly seen that all the basidia conformed to a single type of structure, the differences observable being entirely due to two minor modifications of the typical form: 1, the relative length of the two or three fertile cells of the basidium; 2, the relative expansion into a clavate form of the two or three fertile cells constituting the basidium.

In *Tubercularia vulgaris*, Tode, the conidial condition of *Nectria cinnabarina*, Fries (Pl. **16**. fig. 15), the spore-bearing structure s farthest removed from the typical form of a Protobasidiomycete basidium as illustrated by that of *Stilbum vulgare*; the fertile cells are much elongated, perfectly cylindrical, and not thicker than the supporting hypha.

Intermediate between this primitive type and the true basidium-form as already stated to exist in *Tubercularia volutella*, Corda, may be instanced the basidia of *Tubercularia subpedicellata*, Schweinitz, where the fertile cells are shortened as compared with those of *T. cinnabarina*, Tode, and collectively form a narrowly clavate body (Pl. **16**. fig. 17).

In *Stilbum fasciculatum*, Berk. & Broome, the conidial condition of *Sphærostilbe gracilipes*, Tul. (Pl. **15**. fig. 13), the basidia are identical in structure with those of *Hirneola Auricula-Judæ*, Berk., as figured by De Bary (**8**), and also with those of *Auricularia sambucina*, Mart., described and figured by Brefeld (**9**). These prove conclusively that the cells composing the basidium may be considerably elongated, and not at all clavate.

*Isaria*, Pers., a genus included in the Hyphomycetes, and containing about eighty species, is closely allied to *Stilbum* and *Tubercularia*, differing more especially in the component fascicle of hyphæ not being cemented into a compact mass, but remaining loose and open, consequently the fertile head is spreading and not globose (Pl. **16.** fig. 18). About twenty-two of the so-called species of *Isaria* are known to form the conidial condition of species of the ascigerous genus *Cordyceps*, Fries, which for the most part are parasites on the bodies of various insects. The remaining species grow on wood and various decaying vegetable matter, dung, &c., and in all probability do not at the present day include any ascigerous phase in their cycle of development.

*Isaria pulcherrima*, Berk. & Broome, a beautiful species forming delicate feathery, erect tufts on hard wood, has basidia not at all distinguishable from those of *Stilbum vulgare* (Pl. **16.** fig. 19); and an examination of numerous species of *Isaria* shows exactly the same sequence of structure of the basidia as that already described under *Stilbum* and *Tubercularia*.

Many striking examples of characteristic Protobasidiomycetes, allied to one or other of the three genera mentioned above, are described and beautifully figured by Möller in his excellent work on Brazilian Protobasidiomycetes (**10**); among others may be mentioned *Pilacrella delectans*, Möller, which resembles in general aspect and morphological details *Isaria pulcherrima*, Berk. & Broome.

It has already been stated that, even from the standpoint of the systematist, basing his conclusions on features presented by mature structures only, there is no valid difference between the genera *Stilbum* and *Tubercularia*: many members of both genera are known to represent the conidial condition of species of *Nectria*, whereas other members are almost certainly self-sustaining in every respect, having no other form of fruit included in their life-cycle.

*Isaria*, again, is very closely allied to the two preceding genera, differing only in the less compact sporophore; many species are proved conidial stages of ascigerous forms, as *Cordyceps*; others, again, possess no higher phase of reproduction.

Finally, in all three genera we find exactly the same sequence of progression in the form and structure of the basidia, from what may be termed the conidiophore type, having elongated, unthickened spore-producing hyphal cells, to very short and swollen fertile cells forming the characteristic basidium. This complete transition connecting the extreme poles—conidiophore and basidium—proves that Juel's suggestion to separate those species presenting the typical basidium from the remainder still having the conidiophore form of basidium, cannot be followed, and further proves that the suggestion resulted from an examination of only a limited number of species.

As a rule those species of *Stilbum*, &c., known to be the conidial form of ascigerous fungi have the most primitive basidia, that is basidia of the conidiophore type; whereas the independent species more frequently have typical Protobasidiomycete basidia. To this rule, however, there are marked exceptions, as already shown in the case of the conidial condition of *Sphærostilbe microspora*, where the basidia are short-celled and clavate.

The above discovery further indicates that the Protobasidiomycetes as a group are derived from the conidial phase in the life-cycle of ascigerous fungi; the evolution is effected by the disappearance of the ascigerous form of reproduction, whereby the conidial stage assumes the standard of a species: this change being contemporaneous with the gradual conversion of the so-called conidiophore to the typical basidium or spore-bearing organ.

The earlier realization of this fact was probably retarded to a certain extent by the Friesian conception of a Basidiomycete, which required above all things the presence of a compact, continuous hymenial surface. This idea held good until corrected by the researches of De Bary, Brefeld, and Möller.

As already stated, Brefeld supposes the Autobasidiomycetes to be descended from the Protobasidiomycetes through the disappearance of the transverse septa in the basidium, and the gradual concentration of the spores in a definite number at its apex.

To those who can accept an unproved assumption, the basidium of *Tulostoma*, a cylindrical organ without septa, and having three or four spores scattered at intervals throughout its length, looks very much like the basidium of a Protobasidiomycete in which the transverse septa have been arrested; but unfortunately we possess no evidence of the gradual disappearance of septa in the basidia of any known Protobasidiomycete, whereas, on the other hand, it can be demonstrated that the basidia of *Tulostoma* agree in all essentials with so-called conidiophores that pass directly into typical Autobasidiomycete basidia.

Möller, who has made a more extensive and thorough study of the Protobasidiomycetes than any other author, considers that the Protobasidiomycetes and Autobasidiomycetes are two independent groups having a different origin respectively, and sums up his conviction in the following words :—

"Unter den bekannten Thatsachen spricht keine dafür, das eine Protobasidie sich durch Verlust der Theilwände nachträglich zur Autobasidie umgestalten könne" (**11**).

On this point I am quite in agreement with Möller, and see in the instances given below what appears to be a more feasible explanation of the gradual evolution of the Autobasidiomycetes than the required arrest of the transverse septa of the basidia of the Protobasidiomycetes, and the gradual concentration of the spores at the apex of the basidium.

Boulanger has described (**12**) a new genus of fungi—*Matrouchotia*—which under the old dispensation would be placed in the Hyphomycetes, along with *Stilbum*, *Isaria*, &c. The fungus *Matrouchotia varians*, Boulanger, is a much-branched *Stilbum*-like plant, showing every transition from inflated cylindrical conidiophores bearing from three to five spores scattered at intervals over the surface of the conidiophore—exactly as in *Tulostoma*—to the other extreme of presenting a clavate basidium bearing four spores at its apex—exactly as in true Autobasidiomycetes.

A second species belonging to the same genus, *Matrouchotia complens*, Möller, a native of Brazil, has since been described by Möller (**13**). This species corroborates Boulanger's account in every particular. The conidiophores are cylindric-clavate, and bear from three to five spores placed at different levels—again as in *Tulostoma*; while others of the spore-bearing structures are clavate, and bear four spores at the apex. Now in these two instances we have a transition from a conidiophore or *Tulostoma*-like basidium to the form of basidium characteristic of the Autobasidiomycetes, without necessitating the disappearance of transverse septa.

In the genus *Botrytis*, containing about 120 species—again belonging to the Hyphomycetes—four divisions or subgenera are recognized, depending on the gradual change of the conidiophores to what may be called the basidium type. The most primitive section is represented by *Eubotrytis*, where the spores are borne singly at the tips of slender pointed branchlets.

In *Polyactis* the spore-bearing branchlets are slightly thickened and obtuse, and bear several spores. In *Phymatotrichum* the tips of the fertile branchlets are clavate and bear several spicules or incipient sterigmata, each giving origin to a spore. Finally, in the subgenus *Cristularia* the fertile tips are clavate and bear at the apex a variable number of slender elongated sterigmata, each supporting a spore (Pl. **16**. fig. 21); differing only from a true Autobasidiomycete in being considered a Hyphomycete, and in being undoubtedly allied to an assemblage of forms, some of which recede from the typical Autobasidiomycete structure in the basidia.

Compare Pl. **16**. fig. 21 with fig. 20, which illustrates a fertile branch of *Coniophora ochracea*, Massee, a typical Autobasidiomycete. Figures 20 and 21 are copied from sketches made several years ago.

*Isaria umbrina*, Pers., the conidial stage of *Hypoxylon coccineum*, Bull. (Pl. **16**. fig. 22), and *Trichoderma viride*, Pers., the conidial form of *Hypocrea rufa*, Fr. (Pl. **16**. fig. 23), further illustrate the conidial stage of ascigerous fungi having spore-bearing bodies closely resembling the basidia of the Autobasidiomycetes. The resemblance is so close in fact that had these structures been borne by an organism agreeing with our preconceived conception of what an Autobasidiomycete should be, based on the old traditional standard, their conformity with the ideal type would never have been questioned.

## SUMMARY.

1. The conidial condition of certain ascigerous fungi bear their spores on structures morphologically indistinguishable from the basidia of the Protobasidiomycetes.

2. Some members of the same form-genera as those described in paragraph 1, as *Stilbum vulgare*, Tode, have lost the ascigerous condition from their life-cycle, and are accepted as true Protobasidiomycetes; hence we are justified in concluding that the Protobasidiomycetes as a group originated from ancestors that represented the conidial condition of ascigerous fungi.

3. There is no evidence in favour of the suggestion that the Autobasidiomycetes are descended from the Protobasidiomycetes: on the other hand, the evidence in favour of the Autobasidio-

mycetes having been derived by gradual modification of the spore-bearing organs, or basidia of conidial forms of certain ascigerous fungi, is not lacking.

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## EXPLANATION OF THE PLATES.

### PLATE 15.

Fig. 1. *Stilbum vulgare*, Tode. Group of plants. × 50.

2, 3, 4. Tips of basidia of *S. vulgare*, showing progressive nuclear division, × 2000 (after Juel).

5, 6. Basidia and spores of *S. vulgare*, × 2000 (after Juel).

7. Group of ascigerous form of fruit, showing three stipitate conidia-bearing structures in various forms of development, of *Sphærostilbe microspora*, Cooke & Massee, × 50 (from type specimen).

8. Section of conidial form of fruit of *S. microspora*. × 200.

9. Section through stromatic base of *S. microspora*, showing origin of stem of conidial form of fruit, *a*; also ascigerous fruit, *b b*. × 100.

10, 11, & 12. Basidia and spores from the conidial form of fruit of *S. microspora*. × 2000.

13. Basidia and spores of conidial form (= *Stilbum fasciculatum*, Berk. & Broome) of *Sphærostilbe gracilipes*, Tul. × 2000.

### PLATE 16.

Fig. 14. Section through the stroma of *Nectria cinnabarina*, Fries, showing the conidial stage of fructification, *a a* (= *Tubercularia vulgaris*, Tode); and the ascigerous form of fruit, *b*, *b*. × 50.

15. Basidia and spores of the conidial form of fruit of *N. cinnabarina*. × 2000.

16. Basidia and spores of *Tubercularia volutella*, Corda. × 2000.

17. Basidia and spores of *Tubercularia subpedicellata*, Schweinitz. × 2000.

18. *Isaria pulcherrima*, Berk. & Broome, × 30 (from type specimen).

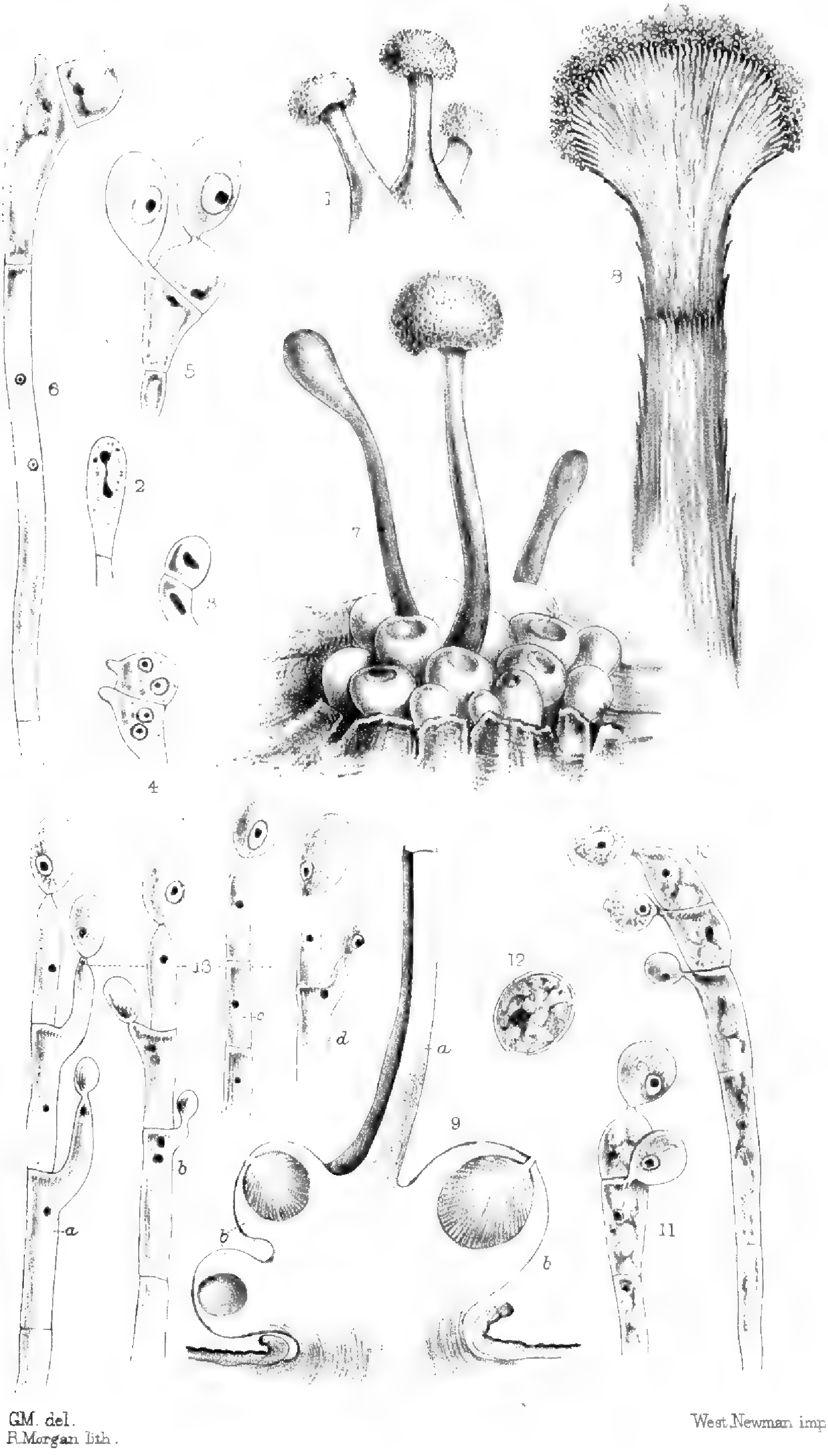
19. Basidia and spores of *I. pulcherrima*. × 2000.

20. Basidia-bearing branch of *Coniophora ochracea*, Massee, × 500 (after Massee).

21. Fruiting branch of *Botrytis tricephala*, Sacc. × 500.

22. Fertile hypha from the conidial stage (= *Isara umbrina*, Pers.) of *Hypoxylon coccineum*, Bull. × 2000.

23. Conidial condition (= *Trichoderma viride*, Pers.) of *Hypocrea rufa*, Fr. × 2000.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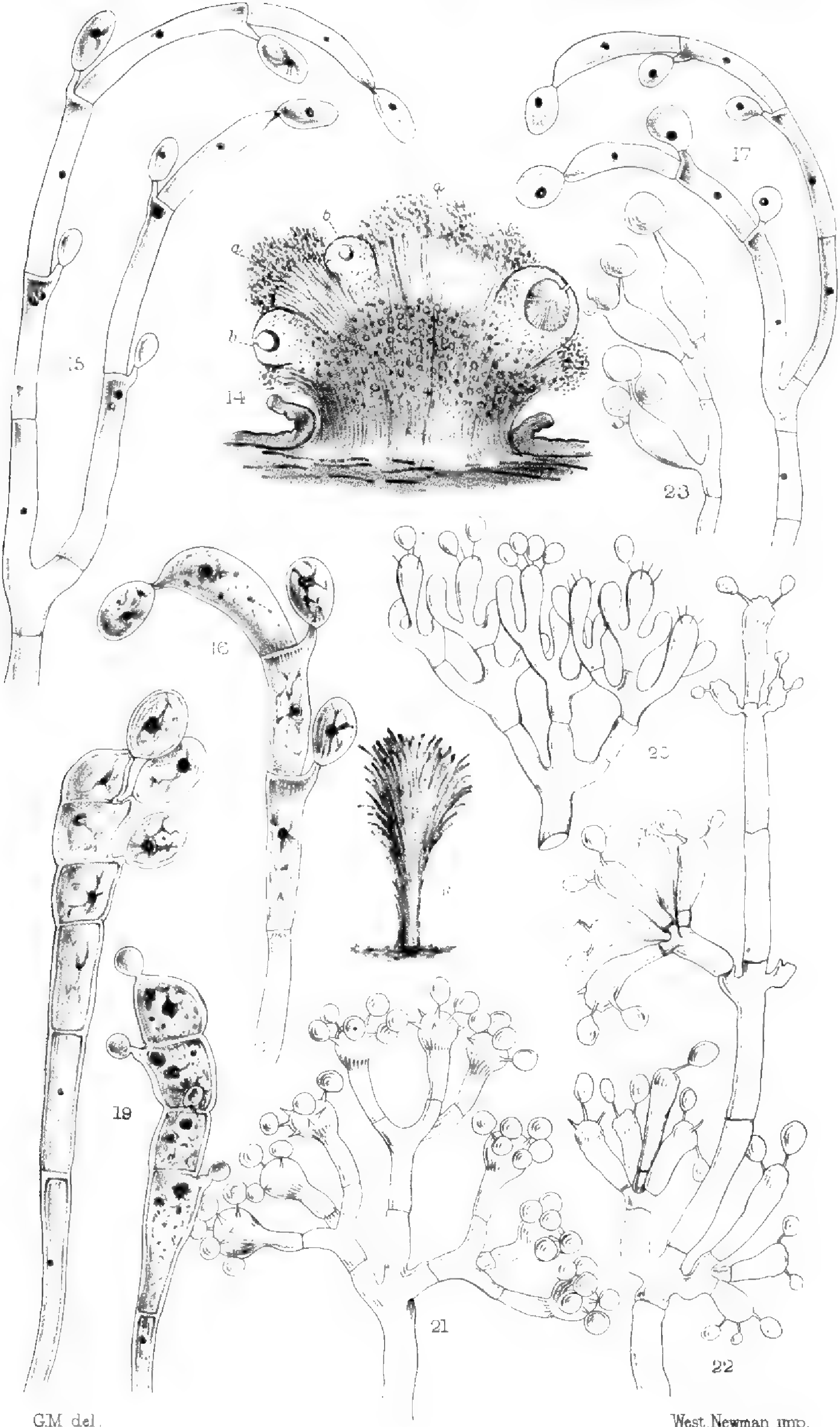
G.M. del.
R. Morgan lith.

West Newman imp.

PROTOBASIDIOMYCETES.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G.M. del.
R. Morgan lith.

West, Newman imp.

PROTO- AND AUTO-BASIDIOMYCETES.

# On some Mosses from China and Japan. By ERNEST STANLEY SALMON. (Communicated by J. G. BAKER, F.R.S., F.L.S.)

[Read 19th April, 1900.]

(PLATE 17.)

THE material on which the following records are based was found in the Royal Herbarium at Kew, and consists for the most part of specimens collected by Mr. C. Ford, F.L.S., Superintendent of the Hongkong Botanic Gardens, Dr. E. Faber, and Dr. A. Henry.

Although but few new species appeared in the collections, several interesting mosses have been found from a geographical point of view. Thus five species—*Gymnostomum inconspicuum*, Griff., *Dicranum lorifolium*, Mitt., *Atrichum obtusulum*, C. Müll., *Polytrichum gymnophyllum*, Mitt., *Papillaria atrata*, Mitt.—hitherto known only from India (mostly from the Himalayan region), have appeared in China; together with six species—*Dicranum crispofalcatum*, Schimp. MSS., Besch., *Physcomitrium japonicum*, Mitt., *Webera scabridens*, Jaeg., *Polytrichum spinulosum*, Mitt., *Plagiothecium lævigatum*, Schimp. MSS., Besch., *Brachythecium Wichuræ*, Broth.—hitherto recorded only from Japan.

Of special interest is the appearance in Japan of *Polytrichum contortum*, Lesq., and *Oligotrichum Lescurii*, Mitt. (see below, pp. 461 & 467). *P. contortum* has been recorded also from British Columbia, California, Alaska, and Saghalien; and *O. Lescurii* from Alaska and Kamtchatka. The distribution of these two species furnishes evidence in favour of the view of the continuity of land in previous times between Japan and America by way of Saghalien or the Kurile Isles, Kamtchatka, and the Aleutian Isles (see Asa Gray, in Mem. Amer. Acad. Arts & Sci. vi. p. 448, 1859; and K. Miyabe, in Mem. Boston Soc. Nat. Hist. iv. 1890, nr. 7, pp. 207, 211, 212).

*Plagiothecium micans*, Par., hitherto known only from North America, has now been collected at Hongkong.

I wish to express my thanks to Mr. C. H. Wright, of Kew, for kindly giving me information on many points.

## WEISIACEÆ.

WEISIA VIRIDULA, *Brid.*—Japan: Miyanoshila, c. fr. (C. Ford, Oct. 1890, no. 295).

GYMNOSTOMUM INCONSPICUUM, *Griff.* (Pl. 17. figs. 12–18).—China: Mt. Omei, Szechuen (Dr. E. Faber, no. 1111).

This species was originally discovered by Griffith in India ("in rupibus madidis, Churra Punjee," Khasia), and published by him in 1849 (Not. ii. p. 394). Up to the present time nothing more seems to have been known about the moss. Mitten when writing the "Musci Ind. Or." had not seen the plant, which he placed doubtfully in the genus *Hymenostylium.* Subsequently, however, Mitten saw the original specimens of Griffith's (which were unnamed), but, apparently overlooking their identity, appended to them the MSS. name of *Gymnostomum* (*Hymenostylium*) *triquetrum*, Mitt. These specimens (now in the Kew Herbarium) are labelled as follows:—"On dripping rocks, Khasia Mountains, No. 26"; "on dripping limestone rocks, Devil's Hole, Churra, No. 843," and "Moosmai, in caves with *Targionia*, no. 174." Griffith's specimens have only a very few capsules, and are (perhaps through age) uniformly flavescent in colour; the Chinese examples are bright green above, and abundantly fruiting, with capsules of a bright copper colour. *G. inconspicuum* shows affinity with *G. curvirostre*, Hedw., from which it differs in the more robust habit, larger, wider, more patulous leaves, not recurved at the margin, and in the capsules being of the colour of those of *G. aurantiacum.* The following description is drawn up from the examination of the Indian and Chinese plants.

G. INCONSPICUUM, *Griff. Not.* ii. p. 394 (1849).

? *Hymenostylium inconspicuum*, Mitt. Musci Ind. Or. in Journ. Linn. Soc., Bot. iii. (1859), Supp. p. 33.

*Gymnostomum* (*Hymenostylium*) *triquetrum*, Mitt. MSS. in Herb. Kew.

Dioicum ?, late cæspitosum, læte viride, inferne flavescens interdum incrustatum, caule erecto 8–10 cm. alto simplice vel plerumque ob innovationes multoties di- raro trichotome diviso flexuoso, foliis confertis triseriatis undique subpatulis siccitate subtortilibus e basi ovata suberecta amplexicauli lanceolatis acuminatis concavo-carinatis, nervo excurrente lutescente, margine plano integro, cellulis pellucidis lævibus superioribus quadratis vel irregulariter et breviter rectangulis inferioribus elongato-rectangulis omnibus ætate parietibus incrassatis interruptis, foliis perichætialibus conformibus, paraphysibus filiformibus, capsula in pedunculo innovando pseudolaterali erecto rubro 7–9 mill. alto gracili lævi oblonga vel obovata erecta parvula circiter 1 mill. longa

aurantiaca nitente, collo indistincto siccitate subplicato instructa, operculo longe et oblique subulato-rostrato, calyptra cucullata angusta paululum infra operculum descendente.

GYMNOSTOMUM AURANTIACUM, *Par.* — China: Mt. Omei, Szechuen (Dr. E. Faber, no. 1112).

## DICRANACEÆ.

TREMATODON LONGICAULIS, *Rich.*—China: on a granite rock near the Canton Bazaar, Hongkong, c. fr. (Dr. W. T. Alexander, Mar. 1846, no. 16); Hongkong, c. fr. (C. Ford, Mar. & Nov. 1889, nos. 158, 206).

DICRANELLA OBSCURA, *Sull. & Lesq.* (Pl. **17.** figs. 21–29).— Dioica, tenella vel elata, dense lateque cæspitosa, cæspitibus mollibus vix sericeis luteo-viridibus, caule erecto vel ascendente-erecto ½–3 mill. alto simplice sæpe flexuoso inferne fusco-viridi, foliis dense confertis erecto-patentibus interdum subsecundis superioribus flexuosis e basi subvaginante oblonga vel obovata subulatis canaliculatis integris vel plerumque summo apice minute et parce denticulatis, margine plano, nervo percurrente latiusculo, cellulis in basis parte superiore angustis elliptico-rectangulis vel elongato-rectangulis incrassatis, in parte inferiore latioribus, foliis perichætialibus e basi longiore magis vaginante subulatis interdum curvatis, capsula in pedunculo erecto 5–25 mill. longo tenui flexuoso lævi stramineo polymorpha, nunc ovato-cylindrica 2 mill. longa erecta æquali, nunc ovato-globosa 1 mill. longa inæquali, ætate plerumque plicata, brunnea sæpe sub ore constricta annulata, annulo lato revolubili, operculo oblique subulato-rostrato, calyptra cucullata lævi, peristomii dentibus rubris ad medium vel ultra bifidis, cruribus pallidis papillosis, sporis majusculis 18–22 μ diam. minutissime asperulis.

Planta mascula femineæ conformis, sed gracilior, simplex vel sub flore terminali gemmiformi innovans, foliis perigonialibus externis e basi lato vaginante subulatis, internis late ovatis subito acuminatis, omnibus nervatis, paraphysibus numerosis filiformibus.

A *D. heteromallæ*, Schimp. formibus omnibus cellulis basis folii superioribus angustis incrassatis, annulo lato nec non sporis multo majoribus distincta; *D. amplexanti*, Mitt. et *D. divaricatæ*, Mitt. affinis, sed foliis dense confertis longe recedens.

China: moist shady bank opposite Hongkong (Dr. W. T. Alexander, Mar. 1845, no. 14); on the ground on a mountain-top, Tung-zan (idem, Feb. 1846, no. 15); Hongkong (Wilford,

no. 274) (C. Ford, 1888, 1889, 1890, nos. 16, 157, 159, 160, 202, 203, 205, 212, 273, 276, 277).

Wilson (3. p. 273), who examined Dr. Alexander's specimens, remarked as follows:—"*Didymodon proscriptus*, Hornsch. (?) var. seta duplo vel triplo longiore. In habit this moss is a *Trichostomum*, but the peristome is that of *Dicranum*. It is closely allied to *D. longirostris*." On the same specimens, and on those collected by Wilford, Mitten has written "*Cynodontium costatum*, M.," but this name has not been published. The excellent specimens which have been sent subsequently by Ford, show clearly that the species is very variable in many characters, especially in the degree of robustness of the stems and in the size and shape of the capsules. In some examples (Ford, nos. 16, 159) the stems are very short, often under 5 mill. high, with a short ovate or globose-ovate capsule, often more or less gibbous, wide or almost truncate at the mouth, on a short seta; the whole plant barely 2 cent. high. In these small states, with the small inclined wide-mouthed capsule, *D. obscura* much recalls in general appearance *D. heteromalla*, but may be at once distinguished by the narrow incrassate cells at the shoulders of the more sheathing base of the leaves, the wide annulus, and spores of nearly twice the size. In other specimens (nos. 157, 160, 202, 203) the stems reach to 3 cent. in height, and the whole plant to 5 cent. or more, and the capsule becomes sub-cylindric and often symmetrical, with a narrower mouth.

I am indebted to Mr. Mitten and Prof. W. G. Farlow for kindly sending me authentic specimens (now in the Kew. Herb.) of *D. obscura*, which enabled me to establish the identity of the plants in the Kew Herbarium.

DICRANUM CRISPOFALCATUM, *Schimp. MSS.*, *Besch.*—China: Mount Omei, Szechuen, barren (Dr. E. Faber, no. 1109).

D. LORIFOLIUM, *Mitt.*—China: Tientai Mt., 2000 ft., Prov. Chekiang, c. fr. (Dr. E. Faber, 1889, no. 6).

Through some mistake this species is described in Journ. Linn. Soc., Bot. iii. (1859) Supp. p. 15, as having the cells of the leaf "haud interruptis"; in all the specimens examined, however, including the type, the cells are porous from the base to the apex of the leaf.

D. JAPONICUM, *Mitt.*, var. YUNNANENSE, var. nov., foliis et foliorum cellulis laticribus, capsula majore (5 mill. longa) erectiore haud arcuata.—China: Hupeh, Kuei, on rock, c. fr.

(Dr. A. Henry, July 1888, no. 6165). The larger, more erect, only slightly curved capsule, and the leaves slightly wider towards the base, with the cells throughout wider, seem sufficient to mark off the present plant as a variety of *D. japonicum*. In Schimper's Herbarium there are two specimens (both barren) of a moss from Japan (Savatier) named in Schimper's handwriting "*Dicranum subscoparium*"; one of these belongs to the present variety of *D. japonicum*, and the other appears to be a narrow-leaved form of the same species. Paris (Index Bryolog.) refers "*Dicranum subscoparium*, W. P. Sch., in Savatier M. Jap. no. 91," to *D. cæsium*, Mitt., a species quite distinct from *D. japonicum* in the small non-porous upper cells, quadrate-elliptic or shortly rectangular in shape, and asperous at the back, and in the peculiar irregularly thickened (bistratose) margin, with frequently a double row of serratures, of the upper part of the leaf.

In the Kew Herbarium there is a moss named "*Dicranum japonicum*, Geheeb, sp. nova! (Folia perichætialia arcte longe convoluta longe loriforme acuminata serrulata)," from Japan (Dickins, no. 1429). This is identical with *D. japonicum*, Mitt.

CAMPYLOPUS DOZYANUS, *Jaeg.*—China: Hongkong (barren and ♀) (C. Ford, Oct. 1889, no. 216). This species has not apparently been hitherto recorded from China. The Hongkong plant agrees better, in possessing rather long hyaline leaf-points and in the nerve being lamelligerous at the back (often quite similar in this respect to *C. polytrichoides*, De Not.), with *C. Dozyanus* than with the closely allied *C. nigrescens*, Jaeg. Sande Lacoste (6) has recorded the present species from Japan, and specimens in the Kew Herbarium labelled "Japonia (leg. Textor)" agree exactly with the Hongkong ones.

### LEUCOBRYACEÆ.

I am indebted to Dr. J. Cardot for the following determinations:—

LEUCOBRYUM LUTSCHIANUM, *C. Müll. MSS.*—China: Hongkong (C. Ford, June 1888, no. 17).

L. WICHURÆ, *Broth.*—On *Pinus sylvestris*?, Simodo, Japan (Oldham, Sept. 1861, no. 281). This is probably the moss recorded by Mitten (7) under the name of "*Schistomitrium Gardnerianum*, Mitt. On pine-trees, Nagasaki, Japan (Oldham)."

LEUCOBRYUM SCABERULUM, *Cardot*, sp. nov.—Hongkong (C. Ford, Oct. 1889, no. 222).

L. SALMONI, *Cardot*, sp. nov.—China: Lo Fau Shan, Prov. Kwangtung, 900 ft. (Comm. Hort. Bot. Hongkong, Aug. 1883, no. 81).

### FISSIDENTACEÆ.

FISSIDENS DECIPIENS, *De Not.*—China: moist shaded rock, Sam-sa Bay, c. fr. (W. T. Alexander, Mar. 1846, no. 10) (recorded as *F. adiantoides* by Wilson (**3**)); on stone, Szechuen, N. Wushan, c. fr. (Dr. A. Henry, Sept. 1888, no. 7058).

*F. adiantoides*, var. *Savatieri*, Besch. (**18**. p. 335, & **21**. p. 289) (*F. Savatieri*, Schimp. MSS.), from Japan, appears, from an examination of Schimper's specimens, to be identical with *F. decipiens*.

F. NOBILIS, *Griff.*—China: Hongkong (C. Ford, Sept. 1889, no. 200).

FISSIDENS sp.—China: Hongkong (C. Ford, Nov. 1889, no. 204). This is possibly *F. incrassatus*, Sull. & Lesq. (**5**), but the description given is too incomplete to enable the certain identification.

### DITRICHACEÆ.

DITRICHUM PALLIDUM, *Hoppe*.—Japan (Textor); Tsus Sima (Wilford, May 1859); Nagasaki (Oldham); "prope Yokohama (?) (V. Dickins, 1876)" (named *Lept. Boryanum*, C. Müll., by Geheeb). China: "on trees, Chekiang (Fortune, June 1854)" (named *L. Boryanum*, C. Müll., by Mitten). The present species can be distinguished from *L. Boryanum* by the non-incrassate leaf-cells (see C. Müll. Syn. i. p. 451).

### SYRRHOPODONTACEÆ.

CALYMPERES FORDII, *Besch.*—China: Hongkong (C. Ford, Oct. 1889, no. 208). The name was kindly confirmed by M. Bescherelle.

### TORTULACEÆ.

BARBULA UNGUICULATA, *Hedw.*—China: Hongkong (C. Ford, no. 19). Apparently not hitherto recorded from China.

TRICHOSTOMUM ORIENTALE, *C. Müll.* (Tortula indica, *Hook.*).—China: Hongkong, c. fr. (C. Ford, Aug. & Nov. 1889, nos. 207, 209).—These Chinese specimens frequently bear stalked multicellular gemmæ, borne in dense clusters on the stem in the axils of the leaves, and I have found the same to occur in Ceylon examples of the species (Herb. Ind. Or. Hook. fil. & Thomson, no. 162). The moss described by Bescherelle (**19.** p. 81) as a new species, under the name of *Barbula scleromitra*, from Tonkin, appears from the description to be very close to the present species. Bescherelle says of his species: "Cette mousse diffère du *Tortula indica*, Hook. .... par l'inflorescence et la verrucosité des coiffes et des feuilles. .... La coiffe est scabre dès la base, un peu plus fortement tuberculeuse vers le sommet." The calyptra of *Trichostomum orientale* was described and figured as smooth by Schwaegrichen (Hedw. Sp. Musc. Frond., Supp. i. sect. 1, p. 143, tab. xxxvi.); subsequent authors, as far as I can find, have not mentioned the point, although both Hooker (Musc. Exot. ii. tab. 135. fig. 5) and Dozy and Molkenboer (Bryol. Jav. tab. 81. fig. 19) figure the calyptra as smooth. In all the specimens of *T. orientale* (with young fruit) in the Kew Herbarium, however, the calyptra is rough in the manner described above for "*B. scleromitra.*" The upper leaf-cells are minutely papillose on both sides, and the nerve is very rough at back. There is a moss in the Kew Herbarium from Tai-wan, Formosa (G. W. Playfair, Jan. 1889), determined by Brotherus as *T. orientale.* This is barren and young, but agrees well with the species. *T. orientale* has not hitherto been recorded from China or Japan.

### GRIMMIACEÆ.

RHACOMITRIUM FASCICULARE, *Brid.*—Japan: Kobe (C. Ford, Nov. 1890, no. 290).—These specimens differ from the usual form of the species in the stems having fewer branches, and in the leaves being longer and narrower above, and frequently denticulate at the apex; but, as Mitten (**8**) has already remarked, the differences are too slight to justify the separation in any way of the Japanese plant.

PTYCHOMITRIUM MICROCARPUM, *Par.*—Manchuria: M. Teien Mts., c. fr. (Dr. E. Faber, May 1891, no. 1507). Only known hitherto from the Prov. Schen-Si, China. To Müller's (**11 & 13**) description of the species may be added: "leaves bistratose in the upper half, cells not incrassate, smooth."

PTYCHOMITRIUM FAURIEI, *Besch.*—Japan: Arima (J. H. Maiden, Oct. 1885, no. 71). M. Bescherelle kindly determined the plant.

It may be observed that in the key to the Japanese species of *Ptychomitrium* which M. Bescherelle (21) gives, *P. Fauriei* is separated from *P. sinense*, Jaeg., by possessing leaves "denticulées, à dents courtes," *P. sinense* having leaves "très entières." In the Arima specimens, however, as well as in other examples of *P. Fauriei* (now in the Kew Herb.) kindly sent to me by M. Bescherelle, the leaves are frequently quite entire. A safer distinction between these two species (which are often identical in habit) is found in the shape and areolation of the leaf. In *P. sinense* the leaves are much broader, always triangular in outline, with a broad upper part, which is not or scarcely cucullate, and the cells are distinctly larger, averaging 10 μ; in *P. Fauriei* the leaves are long and narrow in the upper part and strongly cucullate, with the cells averaging 7 μ.

P. POLYPHYLLOIDES, *Par.*—China: glen near Ichang, c. fr. (Dr. A. Henry, Feb. 1888, no. 7913); Hupeh: Changyang (idem, Mar. 1889, no. 7482).

C. Müller (11), in comparing the present species with *P. polyphyllum* (Dicks.), Bry. Eur., describes the leaves as "minutius areolata"; but the cells are in reality slightly larger (and less incrassate). The basal cells of the present species differ in not being incrassate, and the limb of the leaf is wider and irregularly bistratose. In the original diagnosis the capsules are described as "brevissime pedicellata"; but in some specimens determined by Müller in the Kew Herbarium (Bryoth. E. Levier, no. 1525 *b*) the seta is often 5–7 mill. long, and in Dr. Henry's specimens it reaches to over 10 mill.

HEDWIGIA CILIATA, *Ehrh.*, var. VIRIDIS, *Bry. Eur.*—China: on rocks at Pih-quan, c. fr. (Dr. W. T. Alexander, Feb. 1846, no. 3); rocks in the mountains, Chusan (idem, Jan. 1846, no. 4); city-wall, Ningpo (Oldham, 1861). Japan: c. fr. (Textor) (Dickins, no. 77) (Moseley, 'Challenger' Expedition, 1875); rocks, Nagasaki (Oldham, no. 513).

This variety appears to be not uncommon in China and Japan, although it does not seem to have been hitherto recorded from Asia.

## ORTHOTRICHACEÆ.

ORTHOTRICHUM HOOKERI, *Mitt.* — China: Tongolo, Prov. Szechuen, on bamboo, c. fr. (J. A. Soulié, 1893).

A small form, with shorter setæ than usual, but quite agreeing in all other characters. The stomata of the capsule are superficial in this species.

MACROMITRIUM JAPONICUM, *Dozy & Molkenb.*—China: on rocks, large stones, and on the trunks of trees, Chusan, c. fr. (Dr. W. T. Alexander, Jan. 1846, no. 19): Tsus Sima, c. fr. (Wilford, no. 887). Formosa, c. fr. (Oldham).

## FUNARIACEÆ.

FUNARIA HYGROMETRICA, *Hedw.*—China: Omei, c. fr. (Dr. E. Faber, Dec. 1887); Hongkong, c. fr. (C. Ford, Dec. 1889, nos. 149, 210).

PHYSCOMITRIUM JAPONICUM, *Mitt.*—China: moist shady bank opposite Hongkong, Chusan, c. fr. (Dr. W. T. Alexander, 1846, no. 2); Hongkong, c. fr. (C. Ford, no. 150).

Dr. Alexander's specimens were referred to *P. acuminatum*, Bruch & Schimp., by Wilson (3), but that species differs in the shorter, broader leaves, with a much less defined border, and usually less percurrent nerve.

## BRYACEÆ.

WEBERA SCABRIDENS, *Jaeg.*—China: Tientai Mt., 2000 ft., Prov. Chekiang (Dr. E. Faber, 1889, no. 8). Known hitherto only from Japan.

BRYUM (§ RHODOBRYUM) GIGANTEUM, *Hook.*—China: Tientai Mt., 3000 ft., Prov. Chekiang (Dr. E. Faber, 1889, no. 5 bis); Hupeh, Fang, mountain, 7000–9500 ft. (Dr. A. Henry, Aug. 1888, no. 6796); West Szechuen and Tibetan Frontier, chiefly near Tachienlu, at 9000–13,500 ft. (A. E. Pratt, no. 801). Japan: Miyanoshita (C. Ford, Oct. 1890, no. 292).

Very fine examples of the species, although all barren. Some of the specimens (*e.g.* nos. 5 bis, 292, 801) are of a far larger size than that ever attained by *B. roseum*, Schreb., the leaves often measuring over 2 centimetres long. The species seems to have been much confused with *B. roseum*: in the Kew Herbarium there are two specimens from Japan

(Dickins) named "*B. roseum*" by Mitten; these, however, both belong to *Bryum giganteum*. Mitten (**8**) remarks that *B. roseum* is reported by Dozy and Molkenboer from Japan, "and also mentioned by Sande-Lacoste as *B. giganteum*, Hook." It seems to me, however, more probable that the "*B. roseum*" of the first-named authors was *B. giganteum*. As the two species are frequently barren, and as they often occur of the same size, it may be worth while to point out another distinguishing character of the leaves besides that of the difference in the marginal teeth given by Müller (Syn. i. 247–248). This is found in the nerve-structure of the leaves; in *B. giganteum* a transverse section of the nerve shows, towards the centre, a varying number of very thin-walled cells ("begleiter"-cells), and an entire absence throughout the nerve of any thick-walled cells; in *B. roseum* the fewer "begleiter"-cells are always accompanied by a group or groups of thick-walled "stereid"-cells.

BRYUM PSEUDO-TRIQUETRUM, *Hedw.*—China: Szechuen, c. fr. (Dr. A. Henry, May 1888, no. 5593). A form with the nerve more excurrent than usual.

### MNIACEÆ.

MNIUM ORTHORRHYNCHUM, *Bry. Eur.*—China: Tientai Mts., 2000 ft., Prov. Chekiang, c. fr. & ♂ (Dr. E. Faber, 1889, nos. 3, 19).

M. SUCCULENTUM, *Mitt.*—Japan (Moseley, 'Challenger' Expedit., April–May, 1875).

These specimens were so named by Mitten, and are identical with Indian examples of the species. They are not, however, mentioned by Mitten (**8**) in his account of the Mosses of Japan, and the species has hitherto been recorded only from India, and doubtfully from Java.

M. TRICHOMANES, *Mitt.*—Manchuria: M. Tsien Mts. (Dr. E. Faber, no. 1509); Nank'ang-fu, Kiukiang (Miss Reid).

M. DECRESCENS, *Schimp. MSS.*, *Besch.*—The plant described under this name by Bescherelle (**18.** p. 344) is labelled "*M. decurrens*, Schpr." in Schimper's Herbarium at Kew.

M. CURVULUM, *C. Müll.*—China: on stone, Hupeh, Fang (Dr. A. Henry, Sept., no. 6933).

The plants agree perfectly with authentic examples of this species in the Kew Herbarium (Bryoth. E. Levier, nos. 915, 2137) in habit, areolation, &c., but the leaves are slightly more obtuse, and their teeth fewer. As, however, species of *Mnium* are well known to be variable in the degree of obtuseness and amount of serration of the leaf, it seems quite safe to consider Dr. Henry's plant a form of the species. *M. arcuatum*, Broth., from Japan (**22**) is evidently very close to *M. curvulum*, but, in the few stems that I have seen, the areolation of the leaves is slightly larger and the perichætial bracts different. It seems extremely probable, however, that *M. curvulum*, C. Müll., is not distinct from *M. immarginatum*, Lindb. MSS. Broth. Enum. Musc. Caucas. p. 12 (1892), from the Caucasus. The habit, shape, areolation, &c. of the leaves are identical; and although Lindberg describes the stem of *M. immarginatum* (of which only barren and female plants are known) as "simplex," while Müller (**11**) says of his species "caulis fertilis apice in ramulos paucos perbreves fasciculatim divisus," it is possible that the branching described for *M. curvulum* is caused by innovations subsequently arising beneath the perichætium. The capsules of the fruiting specimens of *M. curvulum* described by Müller were deoperculate; in Dr. Henry's specimens a single capsule with a conical-obtuse lid was present.

## BARTRAMIACEÆ.

BARTRAMIA POMIFORMIS, *Hedw.*, var. CRISPA, *Bry. Eur.*—China: Tsus Sima, c. fr. (Wilford, May 1859, no. 890); Tientai Mt., 2000 ft., Prov. Chekiang, c. fr. (Dr. E. Faber, 1889, no. 4).

There is a moss in Schimper's herbarium named "*Bartramia crispata*, Schpr."; this has been described as a distinct species, under this name, by Bescherelle (**18**. p. 348), with the description:—"Monoica, *B. pomiformi* var. *crispa* simillima, foliis tamen paulo longioribus, margine supra basin leniter revolutis, dentibus acutioribus geminatis diversa." I have failed, however, to find any characters separating this moss from the var. *crispa* of *B. pomiformis*, which shows the revolution of the margin and the serration in two rows here given as characters of "*B. crispata*."

B. HALLERIANA, *Hedw.*—China: North Wushan, on rocks, 6000–8000 ft. (Dr. A. Henry, Sept. 1888, no. 7151); Tibet, Yatung, 27° 51′ N., 88° 35′ E., c. fr. (H. E. Hobson, 1897).

PHILONOTIS SOCIA, *Mitt.*—Besides the original specimens from Nagasaki, Japan, there are examples referred to this species by

Mitten, in the Kew Herbarium, from Tsus Sima, China (Wilford, May 1859).

PHILONOTIS PALUSTRIS, *Mitt.*—In the original diagnosis Mitten (7) describes the species as "Monoica . . . flore masculo perichætio proxima," but through some error of printing the remark follows "The male flower has not been seen." Examination of the type shows the male flower to be terminal on a short special branch near the perichætium; the perigonial bracts are lanceolate acuminate from an ovate-oblong sheathing base, with the nerve longly excurrent, paraphyses numerous, filiform or slightly enlarged upwards. There are examples of the species, named by Mitten, in the Kew Herbarium, from Formosa (Oldham) and Japan (Moseley, 'Challenger' Expedit.).

It seems possible that the moss lately described by Bescherelle (18) as *Philonotula Savatieriana* may be the same as the present species. Bescherelle says of his species, "Cette mousse paraît se rapprocher davantage du *P. palustris*, Mitt., . . . la nervure foliaire dentée, papilleuse, les feuilles caulinaires dressées, les raméales non carénées du *P. Savatieriana* distinguent suffisamment cette espèce du *P. palustris*." In Mitten's type specimens, however, the cauline leaves are only slightly secund, the branch-leaves (except in the strongest branches) hardly keeled, and the nerve of the leaf is decidedly rough with minute scattered points.

## POLYTRICHACEÆ.

ATRICHUM OBTUSULUM, *C. Müll.*—China: side of bank, mountain, 6000 ft., Szechuen, S. Wushan, c. fr. (Dr. A. Henry, June 1888, no. 5888 partim); Hupeh, Fang, c. fr. (idem, Sept. 1888, no. 7482 A). An interesting occurrence, the species being hitherto known only from the Himalayas.

POLYTRICHUM (§ POGONATUM) THELICARPUM, *C. Müll. in Nuov. Giorn. Bot. Ital.* iii. p. 94 (1896), from Prov. Schen-Si, China, is, according to authentic specimens, determined by Müller (Bryoth. E. Levier, nos. 905, 1048), identical with *P. urnigerum*, Beauv.

P. GYMNOPHYLLUM, *Mitt.*—China: Yunnan, S. of Red River from Manmer (mountain forest), c. fr. (Dr. A. Henry, no. 10347).

An interesting addition to the Chinese Flora. The species has hitherto been known only from India (Sikhim, Khasia, Manipur) and Lower Burma (Moulmein). Mitten (Journ. Linn. Soc. iii. (1859) Supp. p. 153) describes the stem-leaves as being without lamellæ, but in many leaves, more especially in the case of the Chinese examples, there are a few low ridges on the ventral surface of the nerve, which evidently represent lamellæ (see Pl. **17**. fig. 19).

POLYTRICHUM GRANDIFOLIUM, *Lindb.*—Japan: Nippon (leg. Savatier) (in Schimper's Herbarium under the name *P. fastigiatum*, Mitt.). The specimen agrees perfectly with Lindberg's description of the species, and with the specimens recorded by Mitten (**8**), collected by Bisset in Japan.

The species is evidently closely allied to *P. fastigiatum*, Mitt., from the Himalayas, but differs in the translucent narrower border of the lamina, the narrower longer cells of the base, and the verruculose terminal cells of the lamellæ. In *P. fastigiatum* the margin of the lamellæ is sometimes formed of two cells, as in *P. grandifolium* (see Pl. **17**. figs. 42–45), but the cells are quite smooth. In *P. grandifolium* the lamellæ have occasionally an unthickened margin (see figs. 43, 46), but this is much more frequently the case in *P. fastigiatum*, which, in fact, serves to connect the two divisions A and B of Lindberg's classification (Observat. de form. præs. europ. Polytrich. pp. 98, 99).

P. CONTORTUM, *Lesq.*

In 1860 Sullivant and Lesquereux (**5**) described a moss under the name of *Pogonatum japonicum* from "mountains north-east of Hakodadi, Japan." In the Kew Herbarium there are two specimens named "*P. japonicum*"—one labelled "Japonia (Textor)," the other "Yezo, Mt. Luwozen, Aug. 1893, leg. Miyabe, com. Brotherus." Both these specimens agree perfectly with *P. contortum*; and in the original diagnosis of *P. japonicum* the characters given are those of *P. contortum.*

Brotherus (**22**) records the above-named plant from Yezo as *P. japonicum*, and refers to the same species examples from Fuji-no-yama (no. 47) and Chickibu (no. 24), collected by Mayr in 1890. These two latter specimens were sent to Kew in 1891 by Brotherus as *P. contortum*, so that it appears that this author has only lately regarded the Japanese plant as a distinct species. I feel convinced, however, that *P. japonicum* is identical with *P. contortum*; and it may be observed that the characteristic bistratose margin of the lamina (see Sulliv. Ic. Musc. Supp. tab. 42.

fig. 6) is well marked in the Japanese examples. *Polytrichum contortum* has hitherto been recorded from British Columbia, California, and Alaska, and in Asia from Dui, Saghalien.

POLYTRICHUM SPINULOSUM, *Mitt.*—China: Tientai Mt., 3000 ft., Prov. Chekiang (Dr. E. Faber, 1889, no. 20). New to China; originally recorded from Japan (Nagasaki), and there are other Japanese specimens in the Kew Herbarium from Miyanoshita (C. Ford, 1890, no. 297), also from Yokoska, Nippon (Savatier, 1878, in Schimper's Herbarium under the MSS. name of *Pogonatum acaule*, Schimp.).

The leaves of this interesting species are entirely without lamellæ. Mitten (**7**) considers the plant nearest to *P. Gardneri*, Jaeg., of South America, and in habit, shape and areolation of the leaves the two species certainly show affinity; it may be observed, also, that in some leaves of *P. Gardneri* the lamellæ become very low or even obsolete. Even closer, however, to *P. spinulosum* is *P. abbreviatum*, Mitt., another S. American species, as in this moss some leaves are quite destitute of lamellæ. Although *P. spinulosum* is thus evidently too closely allied to other species to be placed in even a separate section of the genus, on the other hand it tends, by the total absence of lamellæ, to approach the genus *Rhacelopus*, which seems, however, distinct in the different type of areolation and in the rough seta.

The plant described as a new species, under the name of *Pogonatum pellucens*, by Bescherelle (**18.** p. 351), is the present species. Bescherelle remarks: "D'après la diagnose qu'en donne l'auteur, notre mousse aurait de grandes affinités avec le *P. spinulosum* Mitt. de Nagasaki; les feuilles rigides non incurvées, entières de la base à la partie cuspidée et non *dense spinuloso-dentata*, l'en éloignent suffisamment." Mitten's description of the leaves as "*spinuloso-dentata*" applies more especially to the minute lowermost leaves, the margin of which is irregularly cut to below the middle; the upper leaves are entire from the base to near the cuspidate apex, where the margin as well as the excurrent nerve become spinulosely dentate.

P. CONVOLUTUM, *L.*, var. CIRRATUM, *C. Müll.*—China: Lo Fau Shan, c. fr. (C. Ford, Aug. 1883, no. 82).

In some examples of this species from Java, in Schimper's Herbarium, the leaves have a serrate base, and the capsule is papillose (see Dozy & Molkenb. Bryol. Jav. p. 44, tab. 34. figs. 14, 17), and in these specimens the lamellæ are only one cell high. The Chinese specimens have an entire margin to the leaf-base, the capsule is smooth, and the lamellæ in section are composed of two cells. In examples, however, from Sumatra, Philippines, &c., the same characters occur as in the Chinese plant; and in a form from Sumatra we find leaves with an entire base, yet with lamellæ only one cell high. Lindberg (Observat. de form. præs. europ. Polytrich. p. 103) remarks of *P. cirratum*, "Lamellæ humillimæ, fere inconspicuæ, a singula vel duabus cellulis formatæ."

POLYTRICHUM ALOIDES, *Beauv.*—China: Lo Fau Shan, 3100 ft., c. fr. (C. Ford, Aug. 1883, no. 15); Tientai Mt., 2500 & 3000 ft., Prov. Chekiang, c. fr. (Dr. E. Faber, 1889, nos. 10, 26); Ku-ling (Miss Reid).

In examining these Chinese specimens of *P. aloides*, I was surprised to find that the terminal cell of the lamellæ (as seen in transverse section) was grooved. In European examples of the species the terminal cell is, as is well known, similar in shape and size to the other cells of the lamella. In specimens from India, however, where the species appears to be not uncommon, the terminal cell nearly always shows a slight depression in the centre, although this peculiarity is not so strongly marked as in Chinese and Japanese examples. In Japan we have a supposed endemic species of Lindberg's, *P. inflexum*, which is very closely allied to, if, indeed, it is distinct from, this form of *P. aloides* with the grooved lamellæ. *P. nipponense*, Schimp. MSS. in Herb. (Yokoska, Nippon, Savatier, 1878), and also *P. Oldhami*, Schimp. MSS. in Herb. Kew ("Japonia, Nagasaka (Oldham) Hooker, 153") belong to the same form of *P. aloides*. *P. yunnanense*, Besch. (**17**. p. 69), which is described as with "lamellis in sectione transversali margine bifidis," seems from the description very close to this Asiatic form of *P. aloides*.

P. (§ POGONATUM) TORTIPES, *Mitt.* (Pl. **17**. figs. 1–9.)

Dioicum, cæspitosum, juniperoideum; caule 1–2 cent. alto simplice inferne nudo, foliis caulinis dense confertis patentibus rigidis siccitate plus minus tortis e basi late ovata vel subcordata integra vaginante circiter 1 mill. longa in laminam lanceolatam obtusato- vel abrupto-mucronatam apice dorso lævem 3–4 mill. longam productis, lamellis (ab uno strato cellularum (4–6) compositis, cellula marginali lævi paullo incrassata rectangulari sæpe indistincte medio impressa) densissime positis omnino fere obtectis,

laminæ margine angustissimo sæpe incurvo e medio ad summum apicem irregulariter serrato, basis cellulis inferioribus rectangularibus, diametro 2–3plo longioribus, superioribus ad angulos et in parte in laminam transeunte laxis 20–30 μ latis plus minus quadratis vel subhexagonis parum incrassatis, laminæ cellulis 20–30 μ latis hexagonis vel subhexagonis, foliis perichætialibus externis parvulis e basi lato erecto in laminam brevem triangularem cuspidatam productis, interioribus erecto-patentibus siccitate incurvis vel tortuoso-incurvis foliis caulinis angustioribus multo longioribus (circiter 10 mill.) e basi erecto vaginante 4–5 mill. longo in laminam angustam lineari-lanceolatam productis, margine magis incurvo, dentibus sæpe obsolescentibus, interdum fructibus binatis, capsula in pedunculo 2–3 cent. alto erecto lævi siccitate sinistrorsum superne torto ovali-cylindrica plus minus inclinata sæpe inæquali tereti ubique grosse papillosa sub ore haud constricta, dentibus 32 brevibus, membrana basilari humili, columella quadrialata, sporis lævibus 20–24 diam.

Planta mascula 1–1½ cent. alta, caule interdum e flore masculo proliferente, foliis perigonialibus late obovatis concavis breviter et abrupte acuminatis, cellulis laxis, lamellis obsoletis vel nullis, paraphysibus filiformibus.

China: "West Szechuen and Tibetan Frontier, chiefly near Tachienlu, at 9000–13,500 ft." (A. E. Pratt, no. 758).

Hitherto known only from Sikkim.

POLYTRICHUM COMMUNE, *Linn.*—China: Hupeh, S. Patung, c. fr., form with the margin of the lamina more or less incurved (Dr. E. Faber, no. 7403); Tientai Mt., 3500 ft., Prov. Chekiang, c. fr. (idem, 1889, nos. 11, 17); on ground in wood, Hupeh, Chienshih, c. fr. (Dr. A. Henry, 1888, no. 5817).

OLIGOTRICHUM LESCURII, *Mitt.*

This species, recorded by Mitten (8) from Japan (Nantaizan, Bisset), was originally found by Kellogg in Alaska, and described by James (Bull. Torrey Bot. Club, vi. 1875, p. 33) as *Atrichum Lescurii.* Hitherto Alaska and Japan have been the only localities known for the plant; I find, however, from specimens in the Kew Herbarium, that the barren moss from Kamtchatka, which in Hooker and Arnott's Bot. of Beechey's Voyage, p. 119 (1841), is referred doubtfully to *Polytrichum contortum,* really belongs to *O. Lescurii.* This occurrence of the species in the intermediate station of Kamtchatka is very interesting, as helping to explain the present geographical distribution of the species.

Other species, at present occurring only in Japan and America, may have previously existed in a connecting belt of land, now represented by the Kurile Isles, Kamtchatka, and the Aleutian Isles.

The generic position of *Oligotrichum Lescurii* still remains, perhaps, a little doubtful. James in referring it to *Atrichum*, remarked:—"The capsule is very short, ovate, with a wide mouth; the peristome and operculum wanting; a loose calyptra of the genus was found." Mitten (**8**) says "The capsule is, when empty, turbinate; the calyptra is small, smooth and shining. It has no resemblance to any species of *Atrichum*." The leaves are remarkable in possessing a few, long, narrow flexuose cilia, sometimes composed of as many as ten cells, on either side at the shoulder of the sheathing base, and also for the bistratose lamina with mamillate cells (see Pl. **17**. fig. 20). This type of leaf is anomalous for both *Atrichum* and *Oligotrichum*, and is most nearly approached in certain species of *Polytrichum*, from which genus, however, the glabrous calyptra and the position and structure of the lamellæ separate the present plant.

## ERPODIACEÆ.

VENTURIELLA SINENSIS, *C. Müll.*—(Erpodium sinense, *Venturi, in Rabenh. Bryoth. Europ.* no. 1211, 1873.)

The moss described from Japan (on bark, 'Challenger' Expedition) by Mitten in 1886 (Journ. Linn. Soc. (Bot.) xxii. 314), as a peristomate species of *Erpodium*, under the name of *E. japonicum*, is, I consider, the same as *V. sinensis*. Brotherus (**22**), however, speaking of Mitten's plant as *Venturiella japonica* (Mitt.), says: "Species *V. sinensi* (Vent.) C. Müll. simillima, sed statura minore, peristomii dentibus latioribus pallidioribus sporisque minoribus dignoscenda." I cannot find, however, any difference in habit or in the peristome of the Chinese and the Japanese plant; in the specimens of the former which I have examined the spores measure 20–30 $\mu$, in the latter 20–28 $\mu$. It may be noted that Müller, in the diagnosis of the genus *Venturiella* given in his recent work on Chinese mosses (**12**), describes the peristome-teeth as "per paria approximata;" although in this author's previous description, in 'Linnæa' (**10**), the teeth are spoken of as "regular." In both the Chinese and Japanese examples that I have seen the 16 teeth are equidistant, as represented in Mitten's drawing (**8**. pl. li. figs. 19, 20).

## HYPOPTERYGIACEÆ.

HYPOPTERYGIUM FAURIEI, *Besch.*—Japan: Kobe (C. Ford, Nov. 1890, no. 283).

In Bescherelle's (**18**) diagnosis of the species the nerve of the "folia stipuliformia" is described as "ad ⅔ producta" and as "disparaissant bien au-dessous de la partie rétrécie." In Ford's specimens the nerve is nearly always excurrent, and forms the cuspidate point of the leaf, although very rarely it vanishes at the base of the point. In an authentic specimen of *H. Fauriei*, however, kindly sent to me by M. Bescherelle, the nerve is similarly variable. Mitten (**7**. p. 156) reports the same kind of variation in *H. japonicum*. Only barren examples of *H. Fauriei* have hitherto been known; Ford's specimens are in fruit (with deoperculate capsules), and show the following characters:—fructibus aggregatis (2–3), capsula in pedunculo longo (2–3½ cent.) flexuoso ruberrimo lævi vel summo apice sublævi turgide vel late oblonga (2–2½ mill. longa, 1¼ mill. lata) horizontali nutanteve subito in pedunculum contracta, peristomio normali, sporis parvulis 11–13$\mu$ diam. lævibus.

## NECKERACEÆ.

LEUCODON DENTICULATUS, *Broth. MSS.*—China: Kiukiang (Miss Reid). Agrees with specimens so named by C. Müller (Bryoth. E. Levier, no. 1491).

ŒDICLADIUM SINICUM, *Mitt.*—Japan: Kobe (C. Ford, Nov. 1890, no. 284). Hitherto kown only from the single locality Tsus Sima (Wilford). The calyptra of this species is cucullate, narrow, smooth, and reaches to a little below the base of the capsule; the operculum is rostrate.

CLIMACIUM JAPONICUM, *Lindb.*—China: Lao-yeh Ling, and other hills near Mukden (H. E. M. James, May–Aug. 1886); Hupeh, Chienshih (Dr. A. Henry, June 1889, no. 5934); Szechuen, N. Wushan (idem, Sept. 1889, no. 7059); Tientai Mt., 3000 ft., Prov. Chekiang (Dr. E. Faber, 1889, no. 5).

*C. japonicum* is only very briefly described by Lindberg (**9**. pp. 232, 249), and no description of the leaves is given. The nerve of the branch-leaves has on the dorsal surface several (2–6) teeth at its apex (in this respect recalling *C. ruthenicum*, Lindb., see

Sulliv. Ic. Musc. Supp. t. 58. figs. 5, 6); and by this character the plant is at once distinguished from *Climacium americanum*, Brid., and also from *C. dendroides*, Weber & Mohr. In Schimper's herbarium at Kew there is an unnamed species of *Climacium* labelled "Java, Junio 1844." This is *C. japonicum*, and is interesting as extending the geographical range of the species.

CLIMACIUM DENDROIDES, *Weber & Mohr.*—Japan (V. Dickins, no. 1424).

PTEROBRYUM ARBUSCULA, *Mitt.*—Japan: Kobe (C. Ford, Nov. 1890, no. 287).

METEORIUM PENSILE, *Mitt.*—Japan: Arima (J. H. Maiden, Oct. 1885, no. 63).

PAPILLARIA ATRATA (syn. *Trachypus atratus*, Mitt.).—China: Ningpo Mts., Prov. Chekiang (Dr. E. Faber, 1889, no. 22).

This species has been recorded hitherto only from India and Ceylon; the Chinese plant has slightly narrower leaves, and those of the branches have slightly longer points and are less cordate at the base. Mitten (in Journ. Linn. Soc., Bot. iii. (1859) Supp. p. 129) describes the species as with smooth cells, but in the original specimens from India and Ceylon, as in the Chinese examples, the stem- and branch-leaves are papillose with a single papilla placed in the centre of the face of each cell.

POROTRICHUM MAKINOI, *Broth.*, forma.—Ape's Hill, side of cliff, Formosa (Dr. A. Henry, no. 1841). Determined by Dr. Brotherus.

HOMALIA GLOSSOPHYLLA, *Jaeg.*—China: Yunnan, Szemao, S.E. forests, 4000 ft., on rock (Dr. A. Henry, no. 12812); Ape's Hill, summit, on rock in dark places, Formosa (idem. nos. 717, 752, 1931, 2023).

## STEREODONTACEÆ.

ECTROPOTHECIUM PERRETICULATUM, *Broth. MSS.*—China: Hongkong (C. Ford, Dec. 1889, no. 218).

Dr. Brotherus reported: "I have examined this moss and found it to be quite identical with *E. perreticulatum*, Broth., a species found in the Liu Kiu Islands, but which I have not yet described."

ECTROPOTHECIUM INFLECTENS, *Jaeg.*—China: Hong-kong (C. Ford, 1890, nos. 214, 279). The inflorescence in this species is autoicous.

ENTODON NANOCARPUS, *C. Müll.*—China: Chefoo Mts., Prov. Shantung (Dr. E. Faber, 1889, no. 13). Capsule slightly wider and seta longer (10-14 mill.) than in the original examples of the species from Schen-Si, in which the seta is about 10 mill. long.

E. JAPONICUS, *C. Müll.*—Japan: Nikko (C. Ford, Oct. 1890, no. 291).

PLAGIOTHECIUM LÆVIGATUM, *Schimp. MSS.*, *Besch.*—China: Shanghai, c. fr. Jan. 1861 (collected probably by Dr. A. C. Maingay).

This species was described by Bescherelle (**18**) from Japanese specimens without fruit, collected by Dr. Savatier. In the set of Savatier's mosses in Schimper's herbarium at Kew the specimens have, like the Chinese ones, a few old capsules.

The following characters may be added to Bescherelle's diagnosis:—Autoicum; floribus masculis gemmiformibus prope femineos positis, foliis perigonialibus ovatis acutis concavis, paraphysibus paucis, foliis perichætialibus exterioribus late ovato-acuminatis, interioribus oblongo-lanceolatis erecto-convolutis longe acuminatis, omnibus integris vel apicem versus minutissime et remote crenulatis, capsula in pedunculo brevi (5 mill.) erecto lævi rubro ovato-cylindrica erecta vel inclinata 1½–2 mill. longa annulata, annulo e cellularum seriebus nonnullis composito.

In the Japanese example the capsule is 1½ mill. long; the Chinese specimen represents a robust form of the species, with the capsule 2 mill. long.

P. SILESIACUM, *Bry. Eur.*—Japan: Kobe (C. Ford, Nov. 1890, no. 289).

P. SUBPINNATUM, sp. nov. (Pl. **17**. figs. 10, 11.)

Robustum, laxe cæspitosum, olivaceo-viride; caule repente elongato parum flexuoso plus minus pinnatim ramoso, ramis patentibus vel patulis complanatis simplicibus approximatis vel remotioribus 1–3 cent. longis, foliis caulinis approximatis patulis subdistichis siccitate vix mutatis ovato-oblongis late breviterque acuminatis sæpe obtusiusculis concavis haud decurrentibus, margine plano subintegro vel apicem versus obsolete denticulato, nervis binis brevibus indistinctis, cellulis anguste vermicularibus obscuris lævibus, perpaucis ad basin infimum laxioribus, alaribus nullis, foliis rameis conformibus. Cætera desunt.

China: Ningpo Mts., Prov. Chekiang (Dr. E. Faber, 1889, no. 23).

*Plagiothecio pycnoptero*, Jaeg. affine, sed habitu robustiore et caule pinnatim ramoso diversum.

The width of the stem (including the leaves) is from 2–2½ mill. The presence of numerous diatoms on the leaves indicates a habitat near water.

PLAGIOTHECIUM MICANS, *Par.*—China: Hongkong (C. Ford, August 1889, no. 225).

I found this Chinese specimen to agree very well with Sullivant's description and figures (Icon. Musc. p. 179, tab. 112) of the species (hitherto recorded only from North America), although it differed slightly from the American material in the Kew Herbarium in possessing a little longer and more finely acuminate leaves. Dr. Cardot, who has specially studied the species, kindly examined a specimen of the Hongkong plant sent to him, and reported as follows:—"La mousse me paraît bien être une forme de l'*Isopterygium micans* (Sw.). Il est vrai que sur les échantillons américains l'acumen des feuilles est ordinairement moins long et moins fin. Vous trouverez, cependant, parmi les échantillons que je vous envoie, un spécimen de la Louisiane qui est identique sous ce rapport à la forme japonaise. L'*I. micans* (Sw.), fort répandu dans les Etats du Sud, et remontant à l'Est jusqu'aux environs de Washington (j'en possède dans mon herbier plus de 80 échantillons de diverses localités), est une espèce assez polymorphe. Je crois cependant qu'il faut en séparer spécifiquement les *I. fulvum* (H. et W.) et *ludovicianum* (R. et C.); mais peut-être devra-t-on réunir ces deux dernières formes en une seule espèce."

PYLAISIA PLAGIANGIA, *C. Müll.*—China: on dry rock, Hupeh, S. Patung (Dr. A. Henry, no. 5481). A form with narrower leaves and fewer alar cells than in the original specimens from Schen-Si.

STEREODON PLUMÆFORME, *Mitt.*—China: Hongkong (C. Ford, June 1888, no. 22); Kiukiang (Miss Reid).

HYLOCOMIUM SPLENDENS, *Bry. Eur.*—Yatung, Tibet, 27° 51′ N., 88° 35′ E. (H. E. Hobson).

### HYPNACEÆ.

BRACHYTHECIUM WICHURÆ, *Broth.*—China: Glen nr. Ichang, c. fr. (Dr. A. Henry, no. 7912).

From Brotherus's clear description (**22.** p. 239), I feel no doubt that this fine *Brachythecium* from China belongs here. In the diagnosis of the Japanese plant, Brotherus describes the seta as 1–1½ cent. high, in Dr. Henry's plant it reaches to 2½ cent.

B. PLUMOSUM, *Bry. Eur.*—China: on stones among wood, Tung-zan Inlet (Dr. W. T. Alexander, Feb. 1846). Japan: Miyanoshita (C. Ford, Oct. 1890, no. 293).

RHYNCHOSTEGIUM CONFERTUM, *Bry. Eur.*—China: Chefoo Mts., Prov. Shantung (Dr. E. Faber, 1889, no. 12). Agrees better with this species than with *R. inclinatum*, Mitt.

R. RUSCIFORME, *Bry. Eur.*—M. Tsien Mts., Manchuria (Dr. E. Faber, no. 1506).

AMBLYSTEGIUM IRRIGUUM, *Bry. Eur.*—Altai Mts., Western Mongolia (Mr. & Mrs. St. George Littledale, 1897).

ANOMODON DEVOLUTUS, *Mitt.*—China: Hongkong (C. Ford, 1879 & 1889, nos. 223, 282).

THUIDIUM CYMBIFOLIUM, *Bry. Jav.*—China: glen near Ichang (Dr. A. Henry, March 1888, no. 7911); Journey from Mukden to Kirin, Chang-pei-shan, 1000–7500 ft. (H. E. M. James, 1886).

T. DELICATULUM, *Mitt.*—China: Hongkong (C. Ford, June 1888, no. 21); Lo Fau Shan, 1000 ft. (Idem, Aug. 1883, no. 69).

T. TIBETANUM, sp. nov. (Pl. **17.** figs. 35–41.)

Cæspitosum, ochraceo-viride, satis robustum; caule arcuato-assurgente depresso irregulariter pinnato- et bipinnato-ramoso eparaphylloso, foliis caulinis erecto-patentibus laxe imbricatis subsecundis e basi vaginante late ovata vel subcordata integra ad angulos subdecurrente in acumen angustum denticulatum acutum abruptius contractis, nervo validiore sub apice evanido, margine infra revoluto, cellulis plus minus ellipticis 10–20$\mu$ longis circiter 5$\mu$ latis minute papillosis parum incrassatis, basilaribus longioribus, alaribus quadratis vel breviter rectangulis, foliis rameis parvis circiter $\frac{1}{2}$ mill. longis e basi late ovata excavato-concava breviter acuminatis vel ovatis acutis, margine denticulato infra plus minus revoluto, nervo ad $\frac{2}{3}$–$\frac{3}{4}$ producto, cellulis quadrato-ellipticis 5–10 $\mu$ longis, cellula apicali simpliciter acuta, foliis ramulinis minutis ovatis acutis, margine plano ubique denticulato, nervo valido ad $\frac{2}{3}$ producto, cellulis parvis subquadratis haud incrassatis, cellula apicali simpliciter acuta. Cætera ignota.

Tibet: Yatung, 27° 51′ N., 88° 35′ E. (H. E. Hobson, 1897).

Species satis robusta ob paraphyllorum defectum memorabilis.

**Pseudoleskea capillata**, *Besch.*, c. fr.—China: Tientai Mt., Prov. Chekiang (Dr. E. Faber, 1889, nos. 24, 25); Hongkong (C. Ford, 1890, no. 275); Nanking (Dr. E. Faber, no. 908); Shanghai, Jan. 1861.

This appears to be a common Chinese moss; there are also specimens in the Kew Herb. from "dry shaded places among stones, Chusan; on stones among trees opposite Hongkong; on stones in the old Fort of Tung-zan" (W. T. Alexander, nos. 37, 38, 39); Port Hamilton; Tsus Sima; Port Chusan, Korea (Wilford).

In Schimper's herb. there is a moss named in Schimper's handwriting "*Amblystegium subserpens*" (from "Yokosko, Nippon," Japan, Savatier). "*A. subserpens*" is maintained as a species in Paris's Index; the moss, however, proves on examination to be *P. capillata.*

**P. macropilum** (syn. *Haplocladium macropilum,* C. Müll.).—China: Shanghai, under trees, a robust form, c. fr. (Dr. E. Faber, no. 1502).

To Müller's (**11**) description of the capsule may be added, "annulo lato e cellularum seriebus nonnullis (2–3) composito."

**Hypnum glaucocarpoides**, sp. nov. (Pl. **17**. figs. 30–34.)

Autoicum, lutescens, *H. glaucocarpo* Reinw. simile, sed gracilius; caule prostrato flexuoso irregulariter pinnatim ramoso, foliis caulinis approximatis vel laxe confertis squarrosis e basi amplexicaule late cordata ad angulos decurrente in acumen breve acutum plus minus reflexum attenuatis, nervo ad $\frac{1}{2}$–$\frac{3}{4}$ producto, rare bifurcato, margine plano ubique denticulato, cellulis quadrato- vel rectangulo-ellipticis firmis circiter 25 $\mu$ longis lævibus, alaribus majoribus quadrato-rectangulis, foliis

rameis approximatis conformibus, foliis perichætialibus ovato- et oblongo-acuminatis erectis enervatis, acumine denticulato, paraphysibus filiformibus; flore masculo gemmiformi prope femineum oriente, foliis perigonialibus ovatis acuminatis enervatis, capsula in pedunculo gracili circiter 15 mill. longo lævi inferne ruberrimo superne pallide rubro oblonga horizontali arcuato-curvata, 1½–2 mill. longa basi attenuata, peristomii externi dentibus lutescentibus dense trabeculatis, interni processibus valde carinatis membrana basilari fere ad dentium medium exserta, ciliis binis longis (dentibus fere æquantibus) interpositis. Cætera ignota.

Manchuria, M. Tsien Mts. (Dr. E. Faber, no. 1504).

*H. glaucocarpo*, Reinw. proximum et simillimum, sed statura graciliore, foliis distantioribus, nervo unico, nec non peristomii interni ciliis bene evolutis distinctum.

## SPHAGNACEÆ.

SPHAGNUM ACUTIFOLIUM, *Ehrh.*—China: Hupeh, Fang (Dr. A. Henry, Sept. 1888, no. 6855).

S. CYMBIFOLIUM, *Ehrh.*—China: Tientai Mt., 3000 ft., Prov. Chekiang (Dr. E. Faber, 1889, no. 21).

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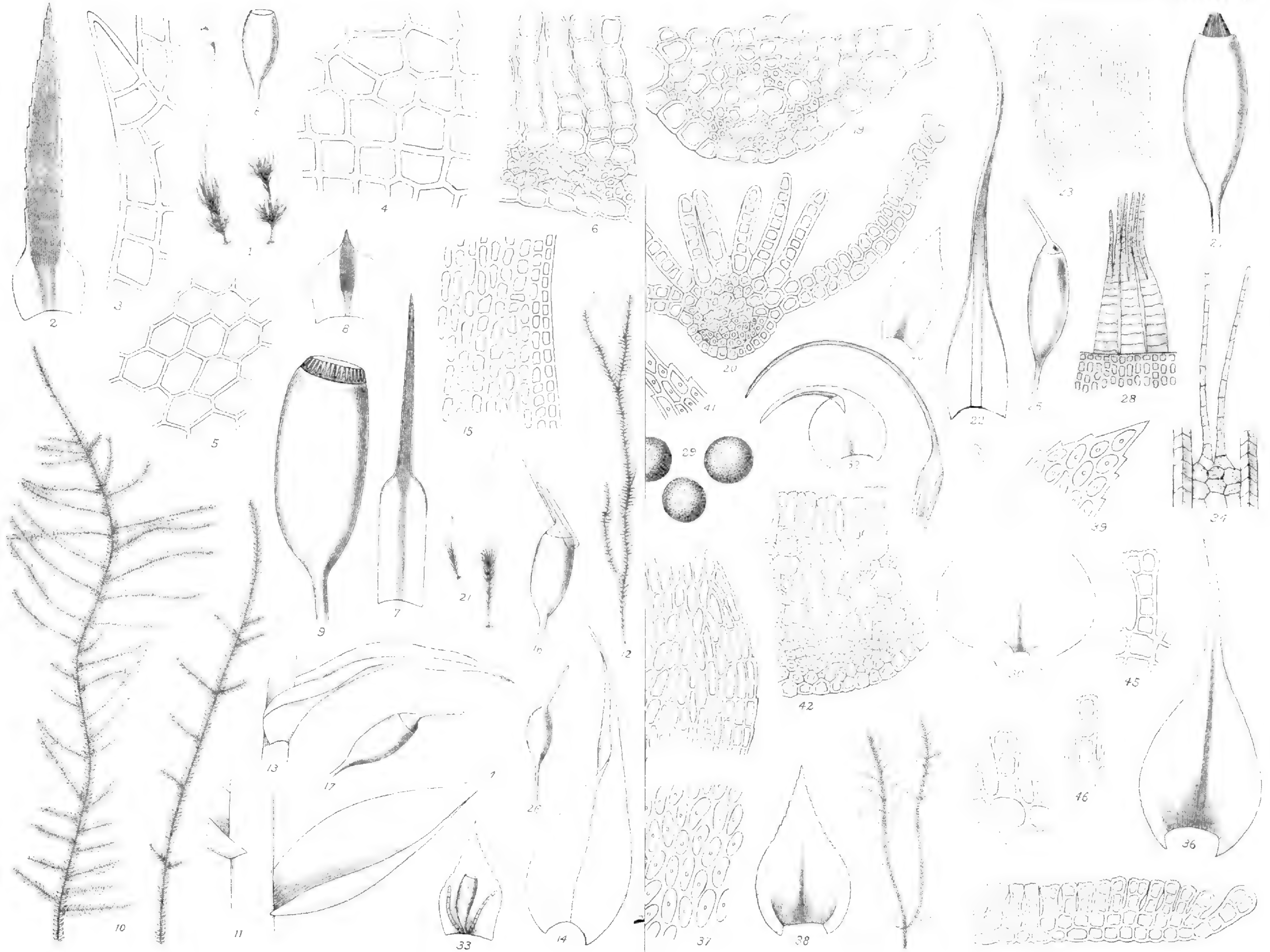
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E.S.Salmon del.

MOSSES FROM C NA AND JAPAN.

A.R.Hammond lith.
Hanhart imp.

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## EXPLANATION OF PLATE 17.

Figs. 1–9. *Polytrichum tortipes*, Mitt.—1, Fertile and male plants, nat. size; 2, leaf, ×12; 3, margin of lamina of same, at one-third from the apex, ×255; 4, areolation at shoulder of leaf-base, ×255; 5, areolation of the lamina at one-third from the apex, ×255; 6, part of a transverse section of a leaf, at two-thirds from the apex, ×255; 7, perichætial leaf, ×6; 8, perigonial leaf, ×12; 9, capsule, ×12.

Fig. 10. *Plagiothecium subpinnatum*, sp. nov., part of two stems, nat. size.

Fig. 11. Stem-leaf of same, ×25.

Figs. 12–18. *Gymnostomum inconspicuum*, Griff.—12, stem, nat. size; 13, 14, two leaves, × 25; 15, areolation of leaf, at one-third from the apex, × 255; 16, 17, 18, three capsules, × 12.

Fig. 19. *Polytrichum gymnophyllum*, Mitt. (from Yunnan, Dr. A. Henry, no. 10347), transverse section of leaf, showing rudimentary lamellæ, × 255.

Fig. 20. *Oligotrichum Lescurii*, Mitt., transverse section of leaf, × 255.

Figs. 21–29. *Dicranella obscura*, Sulliv. & Lesq.—21, two plants, nat. size; 22, leaf, × 25; 23, areolation at shoulder of leaf-base, × 255; 24, perichætial leaf, × 12; 25, 26, two capsules, × 12; 27, capsule with peristome, × 20; 28, three peristome-teeth, × 150; 29, spores, × 400.

Figs. 30–34. *Hypnum glaucocarpoides*, sp. nov.—30, stem-leaf, × 52; 31, areolation of same, at one-third from base, × 255; 32, branch-leaf, × 52; 33, perigonial leaf, and antheridium, × 52; 34, part of inner peristome, showing the well-developed cilia between the processes, × 150.

Figs. 35–41. *Thuidium tibetanum*, sp. nov.—35, part of stem, nat. size; 36, stem-leaf, × 25; 37, areolation of same, at one-half from the base, × 400; 38, branch-leaf, ×52; 39, apex of branch-leaf, × 400; 40, leaf of secondary branch, × 150; 41, apex of same, × 400.

Figs. 42–46. *Polytrichum grandifolium*, Lindb.—42, 43, parts of transverse section of leaf, × 255; 44, 45, 46, three lamellæ, × 400.

# Notes on an Exhibition of Plants from China recently collected by Dr. A. Henry and Mr. W. Hancock. By W. Botting Hemsley, F.R.S., F.L.S., Keeper of the Herbarium, Royal Gardens, Kew.

[Read 5th April, 1900.]

By permission of the Director of the Royal Gardens, Kew, I have selected for exhibition some of the more striking novelties of the collections recently received from the two collectors above named.

Since the publication of my Enumeration of Chinese Plants in the 'Index Floræ Sinensis,' commenced in the Society's Journal in 1886, enormous collections of dried plants have been sent from China to the Herbaria of Kew, Paris, and St. Petersburg, to say nothing of other museums. The greater part of these collections were made in the Central and Western Provinces, previously almost unknown botanically, and they have more than doubled the number of species of flowering plants known from China fifteen years ago. The number of shrubs and herbaceous plants having showy flowers is almost incredible. Every fresh collection contains a considerable percentage of new species. Such familiar genera as *Clematis*, *Rhododendron*, *Lonicera*, *Primula*, *Gentiana*, *Lysimachia*, *Pedicularis*, *Senecio*, and *Saussurea* are represented by upwards of fifty species each, and some of them by upwards of one hundred each. From a very rough calculation I estimate the vascular plants of China at 10,000 species, at least.

The plants I am showing this evening were collected by Dr. Augustine Henry and Mr. William Hancock, both Fellows of this Society, in the neighbourhood of Mengtze and Szemao, in Southern Yunnan, and just within the tropics. Mengtze is at an elevation of 4640 feet, and Szemao at 4480 feet, but what height the surrounding mountains reach I have not been able to ascertain. The greatest elevations given on the labels are from 7000 to 8500 feet.

I should like to add that I received much assistance from my colleague, Mr. S. A. Skan, in comparing the specimens and preparing them for exhibition.

The following plants are specially worth notice :—

ASPIDOPTERYS OBCORDATA, *Hemsl.* (Hook. Ic. Pl. t. 2673, ined.). A new species characterized by having obcordate leaves with a small triangular lobe in the sinus, similar to those of some species of *Passiflora.* The affinities of this small Asiatic genus are not obvious in the flowering stage, because it wants the characteristic glands on the petioles and calyx, and the very thin petals are neither clawed nor fringed.

LESPEDEZA DIVERSIFOLIA, *Hemsl.* (Hook. Ic. Pl. t. 2625), and SHUTERIA SINENSIS, *Hemsl.* (Hook. Ic. Pl. t. 2626), Leguminosæ remarkable for their dimorphic leaves, which exhibit a sudden change from a petiolate condition and ovoid or lanceolate leaflets to a sessile condition and orbicular or cordate, stem-clasping leaflets.

ERYNGIUM FŒTIDUM, *Linn.*—This member of the Umbelliferæ is a native of tropical America, where it is widely spread, ranging from Mexico to Colombia, the West Indies, and Brazil. It is also found in West Tropical Africa, where however it may have been introduced. In America it has some reputation as a medicament, and it is also used for flavouring soups and other culinary purposes, for which it is cultivated. It was therefore a surprise to find specimens of this species in Dr. Henry's collection from Szemao, especially as no other species of the genus is known to exist in Eastern India, China, Japan, or the Amur. Dr. Henry's specimens are under two numbers, from the forests south-east of Szemao, at 4000 to 4500 feet. I can only suppose that it was introduced, by some means, long ago. The fact that it was cultivated in Dutch gardens more than two hundred years ago (Hermann, 'Hortus Academicus Lugduno-Batavus,' 1687, p. 236, cum ic. xylogr.) strengthens this supposition. The further fact that Descourtilz ('Flore Pittoresque et Médicale des Antilles,' viii. p. 317, t. 585) states that Rheede, "observateur du Malabar," recommends it for medicinal purposes, also favours this view. Where Rheede published such a thing I have not been able to ascertain; but it is not, I believe, in his 'Hortus Malabaricus.'

TUPIDANTHUS CALYPTRATUS, *Hook. f. & Thoms.* (Bot. Mag. t. 4908).—A grotesque-looking, large, shrubby member of the Araliaceæ, originally found in the Khasia mountains. Sir William Hooker, *loc. cit.*, says: "This is, perhaps, the most remarkable plant of the order to which it belongs." And Bentham and Hooker ('Genera Plantarum,' i. 947) have the following note:—"Stigmatum series in icone citata [Bot. Mag. t. 4908] falso depicta est, nunquam lineam simplicem centralem formant; in quoque flore ultra 90 enumeravimus." In Dr. Henry's specimens I have counted upwards of 160 cells in one ovary; probably the only species of plant having so large a number. In some respects it recalls *Sararanga sinuosa*, Hemsl. (Journ. Linn. Soc., Bot. xxx. (1895) t. 2; et xxxii. (1896) tt. 4–7; Hook. Ic. Pl. t. 2584), especially in having a large number of carpels sinuously arranged. Dr. Henry's specimens bear ripe seeds, and the new facts brought to light by his specimens will be illustrated in an early part of Hooker's 'Icones Plantarum,' t. 2672, ined.

TREVESIA PALMATA, var. CHEIRANTHA, was exhibited as an instance of extreme variability in the cutting or lobing of the leaves; a character so remarkably exemplified in some New Zealand species of *Panax*.

LONICERA CALCARATA, *Hemsl.* (Hook. Ic. Pl. t. 2632), is a handsome species, remarkable for the long corolline spur.

**LEYCESTERIA SINENSIS**, *Hemsl.* (Hook. Ic. Pl. t. 2633), a new species having subcapitate flowers, was discovered by Dr. Henry associated with *L. formosa*, Wall., and *L. glaucophylla*, Hook. f., the only other species known.

**LYSIMACHIA INSIGNIS**, *Hemsl.* (Hook. Ic. Pl. t. 2634), a species having slender stems about a yard high, bearing two or three leaves at the top, and racemes of flowers on the otherwise naked stems below, was exhibited, together with *L. paradiformis*, Franch., *L. crispidens*, Hemsl., *L. involucrata*, Hemsl., and *L. alpestris*, Champ., to illustrate the very great variety in habit developed by this genus in China, where nearly sixty species are known to exist.

**PLECTRANTHUS CALCARATUS**, *Hemsl.* (Hook. Ic. Pl. t. 2671), is so named in consequence of the large size of the corolline spurs. The original species, *P. fruticosus*, L'Hérit. (Stirpes Novæ, t. 41) has a spur, though a short one, hence the name of the genus. F. Mueller (' Fragmenta,' v. p. 51) seems to have overlooked this fact when describing his P. *longicornis*, which has a much shorter spur than *P. calcaratus*, for he says: "Species propriam generis sectionem nisi genus peculiare (*Ceratanthus*) efformat. cornu procero floris [corollæ] et forme calycis memorabilem.'

**HELICIA GRANDIS**, *Hemsl.* (Hook. Ic. Pl. t. 2631), is a very handsome species of the only genus of Proteaceæ extending northwards into India, China, and Japan. Dr. Henry's collection contains about half-a-dozen new species. It is noteworthy that this genus is represented in Ceylon and the Western Peninsula of India, and westward to Sikkim in the Himalaya mountains.

**QUERCUS REX**, *Hemsl.* (Hook. Ic. Pl. t. 2663, ined.), is an exceedingly handsome species, the leaves of which are at first clothed with a dense woolly, almost golden tomentum, afterwards attaining a foot in length, becoming quite glabrous on both surfaces, glaucous beneath, and in shape and nervation strongly resembling those of some species of *Magnolia*. It is nearest the Malayan *Q. velutina*, Lindl.

QUERCUS FORDIANA, *Hemsl.* (Hook. Ic. Pl. t. 2664, ined.), is a distinct new species, allied to *Q. cornea*, Lour., from which it differs in having very pubescent leaves with much more numerous lateral nerves. It belongs to a small group characterized by a thick bony shell to the nut, and lobed cotyledons, caused by false septa intruded from the endocarp, much as in the walnut but by no means so regular.

ARCHANGIOPTERIS HENRYI, *Christ & Giesenhagen* (Flora, 1899, p. 72, cum figura).—This is one of the most interesting of recent discoveries of new ferns, forming, as it does, a connecting link between *Angiopteris* and *Danæa*. It differs from *Angiopteris* in the absence of "nervuli recurrentes," which are not true nerves, but plates of colourless cells, extending from the margin towards the midrib. The authors give the differences in the following words:—"Differt ab *Angiopteride* soro lineari nec ovali, mediali nec subterminali, indusio majore, sporangiis multo numerosioribus, fronde multo minore, simpliciter nec pluries pinnata, et nervulis recurrentibus nullis." "Differt a *Danæa* stipite rachique exarticulatis, sporangiis haud in synangia concretis."

Recent discoveries in China have increased the number of ferns to about 300 species, including upwards of fifty new ones.

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1. No more than Six volumes shall be lent to one person at the same time without the special leave of the Council or one of the Secretaries.

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THE REVISED RULES concerning the publication of PAPERS have been already made known by circular, but, if required, additional copies may be had on application.

The new regulations in regard to publications in the Journal are as follow:—

Papers read from November and before the middle of January are published on **1st April.**

Papers read after the middle of January and before the end of April are published on **1st July.**

Papers read in May and June are published on **1st November.**

# NOTICE.

Vol. XXVI. is still in course of issue, and the Parts already published are as follows:—

Vol. XXVI., Nos. 173–178.

[Nos. 179–180 are reserved for the conclusion of Messrs. Forbes and Hemsley's 'Index Floræ Sinensis,' of which No. 178 was recently published.]

Vol. XXVII., Nos. 181–188. (Complete.)

Vol. XXVIII., Nos. 189–196. (Complete.)

Vol. XXIX., Nos. 197–204. (Complete.)

Vol. XXX., Nos. 205–211. (Complete.)

Vol. XXXI., Nos. 212–219. (Complete.)

Vol. XXXII., Nos. 220–227. (Complete.)

Vol. XXXIII., Nos. 228–234. (Complete.)

Vol. XXXIV., Nos. 235–240.

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All communications relating to the general business of the Society should be, as heretofore, addressed to the "Secretaries," but letters on library business only should be addressed to the "Librarian."

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OF

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VOL. XXXIV. **BOTANY.** No. 241.

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NOTE.—The Charter and Bye-Laws of the Society, as amended to the 19th March, 1891, may be had on application.

# On the Forms, with a New Species, of *Halimeda* from Funafuti.

By ETHEL S. BARTON. (Communicated by GEORGE MURRAY, F.R.S., F.L.S.)

[Read 3rd May, 1900.]

(PLATE **18**.)

THE following is a short account of the specimens of *Halimeda* collected at Funafuti by the Coral-boring Expedition under Prof. Edgeworth David in 1897. The list includes one new species, and a new variety of *H. cuneata*, Kuetz., which may also prove to be a new species; the other records, with the exception of *H. macroloba*, Decne., and *H. Tuna*, Lamour, are of species already recorded from the Fiji and Friendly Islands by Dr. Askenasy in the 'Voyage of S.M.S. Gazelle,' Theil iv., Bot. Algen, 1888, pp. 13 & 14. *H. macroloba*, Decne., is recorded by other collectors from the Pacific Islands. The numbers given are those of the collection sent home by Prof. David, and now preserved in the British Museum. Their retention in this list may be useful for future reference.

A. 21. HALIMEDA TUNA, *Lamour.* A fragment only.

H. OPUNTIA, *Lam.*, var. MACROPUS, *Ask.*

From 45 fathoms, Funamanu.

A. 31. HALIMEDA LAXA, n. sp. (Pl. **18**. figs. 1–3.)

Ad 40 cm. longa sed imperfecta, e pallido albescens, superne quam inferne omnino minus incrustata, articulo supremo vix incrustato; sparse et vage ramosa, ramis nunc uno, nunc duobus oppositis, sæpe distantibus. Articuli simplices subcylindrici, circa 9 mm. longi (interdum 4 mm.), 2 mm. lati, 1·5–2 mm. crassi; articuli ramigeri superne 5 mm., inferne 2 mm. lati; utriculis corticalibus 50 $\mu$ longis, circa 33 $\mu$ diam., parietibus 7 $\mu$ crassis, bilamellatis, angulis incrassatis.

This plant may be distinguished from all other known species of *Halimeda* by its long straggling habit, few branches, and by the thick wall between the peripheral cells in all but the young joints. It differs from other species with cylindrical joints in the size of its peripheral cells, those of *H. polydactylis*, J. Ag., being 25 $\mu$ across, and those of *H. cylindracea*, Decne., being 50 $\mu$, while *H. laxa* is 33 $\mu$. Neither of these plants shows the thick wall peculiar to the peripheral cells of *H. laxa.* The habit and branching are also different.

37 fathoms, off Tutaga.

A. 34. HALIMEDA LAXA.

35 fathoms, Tutaga.

A. 54. HALIMEDA CUNEATA, *Kuetz. Tab. Phyc.* vol. vii. tab. 21. fig. iii.; var. ELONGATA, nov. (Pl. **18.** figs. 4, 5.)

Ad 25 cm. longa sed imperfecta; vage ramosa. Articuli simplices costati, plano-compressi, 7 mm. longi, medio 3–4 mm. lati, ad extremitatem quamque angustati, 1·5 mm. lati; articuli ramigeri, tripartiti, costati, plano-compressi, circa 1 cm. longi, superne 7–9 mm. inferne 1–1·5 mm. lati; margine undique acuto; utriculis corticalibus 50–60 $\mu$ longis, 33 $\mu$ diam.

This may possibly be a new species, but in the present unsatisfactory state of the genus it seems wiser to consider this plant for the present a variety of *H. cuneata,* Kuetz. It differs from the description of *H. cuneata* in Prof. Askenasy's Algæ of the 'Gazelle' (*l. c.*) in the greater length of the whole plant, and the small size of the peripheral cells, which in the 'Gazelle' specimen measure 50 $\mu$ across. The general form of the joints recalls, however, those of *H. cuneata,* Kuetz. *H. cuneata,* Hering, is a different plant, although Kuetzing's figure quoted above is supposed to represent it. Kuetzing's plant must, therefore, on the revision of the genus, receive a new name.

H. OPUNTIA, *Lamour,* var. MACROPUS, *Ask.*

From 40 fathoms, ocean slope of reef, Funamanu, brought up alive.

A. 58. HALIMEDA CUNEATA, *Kuetz.,* var. ELONGATA.

H. MACROLOBA, *Decne.*

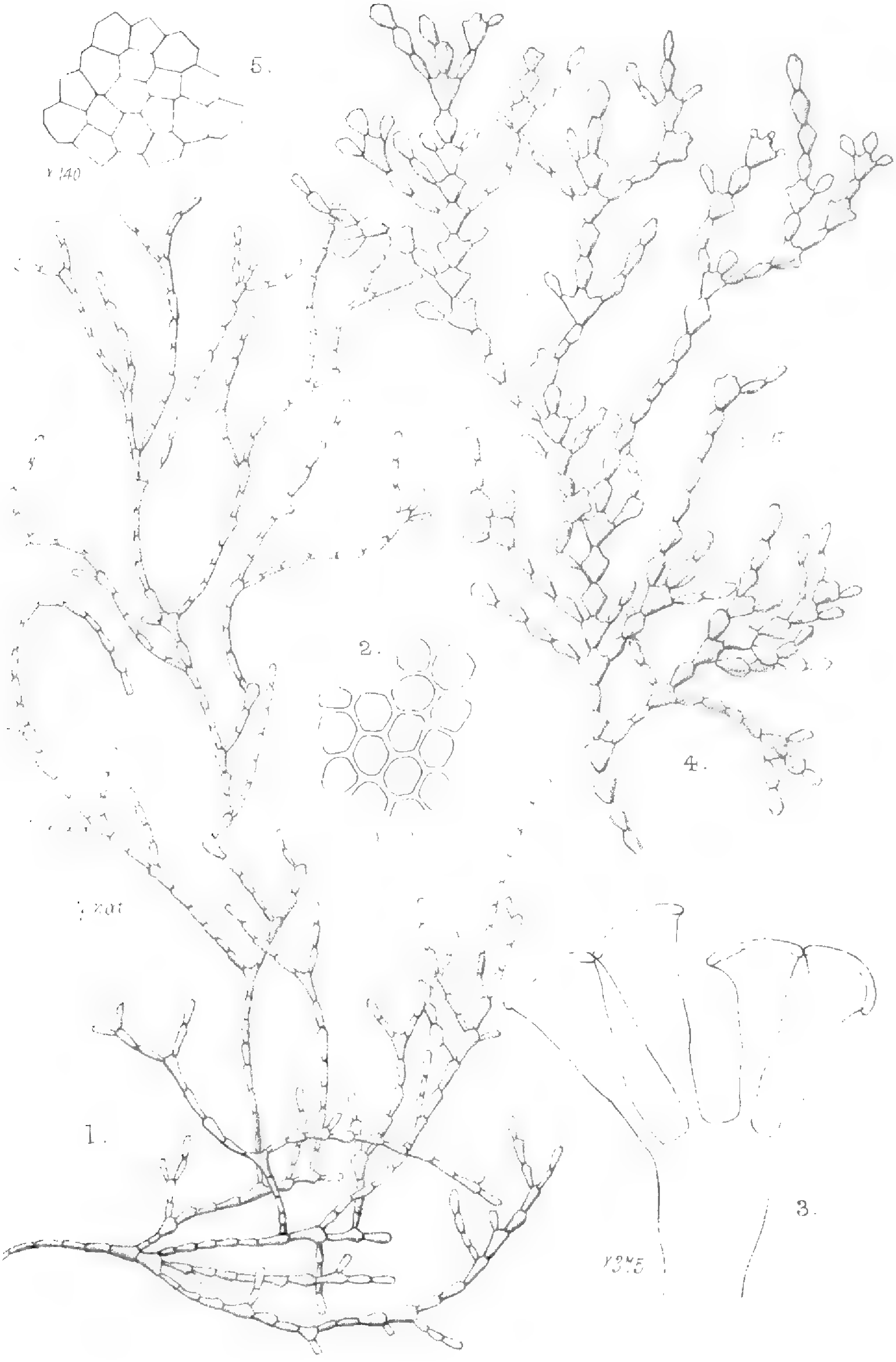
Fragment of H. OPUNTIA, *Lamour,* var. MACROPUS, *Ask.*

Falefatu, 25 fathoms.

B. 5. HALIMEDA OPUNTIA, *Lamour,* var. MACROPUS, *Ask.*

B. 10. HALIMEDA MACROLOBA, *Decne.*?

The peripheral cells of this plant measure 50 $\mu$ across, and it appears to be identical with the plant recorded under this name by Prof. Askenasy (*l.c.*) from Dirk Hartog Island, West Australia. He gives, however, among the references to *H. macroloba* the figure in Harvey's Phyc. Austr. tab. 267, which represents no. 562 of Harvey's Australian Algæ. This plant has been made the


5.
×140
2.
4.
×20
1.
3.
×325

B&H. del. Highley lith.

Mintern Bros. imp.

1-3. HALIMEDA LAXA n. sp.
4, 5. H. CUNEATA Kutz var ELONGATA.

type of *H. versatilis* by Prof. J. G. Agardh in his 'Till Algernes Systematik,' v. p. 86, and an authentic specimen is preserved in the British Museum. This I have examined, and find that the peripheral cells are much smaller in diameter, 25 μ, than either the Funafuti plant or that described by Dr. Askenasy, both of which measure 40 μ and more. The Funafuti plant differs also in colour, thickness, and calcification from *H. versatilis*, J. Ag.

Halimeda Opuntia, *Lamour*, var. macropus, *Ask.*

B. 11 & 12. Halimeda cuneata, *Kuetz.*

The 35-fathom level. Fine large branching *Halimeda* alive.

This specimen is much larger than that kindly sent me for comparison by Dr. Askenasy; but the Funafuti plant appears to be considerably older, and is much thickened at the base. The shape of the joints, the slight calcification of the young joints, the manner of branching, and the size of the peripheral cells are the same in both plants.

The only specimen of *H. Opuntia*, Lamour, which I have seen from Funafuti, was a plant which was made to grow through a hole in a board, in order to calculate the rate of growth. In all other cases, only the var. *macropus* of this species is found.

Specimens of boring taken on the floor of the lagoon were sent for identification, and in all these the *Halimeda*-joints consisted entirely of *H. Opuntia* var. *macropus*. The borings down to 136½ feet were still sufficiently well preserved to show the peripheral cells on decalcification, and at 151 feet the large central tubes were still to be recognized; but below that depth, though the form of the joints was retained, there was no cell-substance after treatment with acid. The 136½ feet includes 101 feet of water, at which depth the floor of the lagoon is reached. Dredgings were taken at 18 points in a straight line across the lagoon, at depths varying from 7½ to 26 fathoms, They all contained joints of *H. Opuntia*, Lamour, var. *macropus*, with the exception of no. 1 ("½ a mile from the Mission Church. Depth 10 fathoms"), in which the fragments were of *H. Opuntia*. In no. 18 I found no *Halimeda*.

My best thanks are due to Prof. Judd, F.R.S., for placing this interesting material in my hands, and to Prof. Askenasy for his kindness in lending me 'Gazelle' specimens for comparison, and for giving me his valuable opinion on the two new forms.

[Since this paper was read, a quantity of *Halimeda* material has come into my hands, and I have been allowed access to some valuable authentic specimens of Kuetzing, Hauck, and others. An examination of these plants shows clearly the necessity for a revision of the genus and a certain modification in the number of the species—a task I hope to carry out later.—19*th Sept.*, 1900.]

### EXPLANATION OF PLATE 18.

Fig. 1. *Halimeda laxa*, n. sp. ½ nat. size.
2. „ „ Peripheral cells, decalcified surface view. × 140.
3. „ „ Ditto, decalcified side view. ×375.
4. *H. cuneata*, Kuetz., var. nov. *elongata.* ½ nat. size.
5. „ Peripheral cells, decalcified surface view. × 140.

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## DICELLANDRA, *Hook. f.*, and PHÆONEURON, *Gilg* (Melastomaceæ).

By Dr. OTTO STAPF, A.L.S.

[Read 7th June, 1900.]

(PLATE 19.)

### I.

THE Melastomaceous genus *Dicellandra* was described by Sir Joseph Hooker in Benth. & Hook. f. Gen. Plant. i. 757, from specimens collected by Barter on the Nun River and by G. Mann in the island of Fernando Po, and the only species then known was named *D. Barteri*, Hook. f. The same author added a second species to the genus in Oliver's Flora of Trop. Afr. ii. 459, from specimens collected by Afzelius in Sierra Leone. This was called *D. setosa*, Hook. f. Since then several Melastomaceæ have been received at Kew from West and Central Africa, which superficially very closely resemble the original *D. Barteri*; indeed, so much so, that Cogniaux enumerates them under this species in his great monograph of Melastomaceæ, p. 546. Among them is a specimen gathered by Schweinfurth in Monbuttuland (no. 3166). When Gilg worked out the Melastomaceæ for the "Nachträge" of Engler and Prantl's 'Natürliche Pflanzenfamilien' and for Engler's 'Monographien Afrikanischer Pflanzenfamilien,' his suspicion was aroused concerning the specific, and even the generic, identity of Schweinfurth's plant with the original *Dicellandra Barteri*, and he asked me to compare both. In my reply (see Gilg in Engl. Monogr. Afr. Pflanzenfam. etc. ii. 35) I told him that, of the specimens referred to *D. Barteri* by Cogniaux, only the two original ones, on which the genus was based, could be retained in this species, the others differing considerably in the structure of the stamens. I added, however, that this difference did not appear to me sufficient to justify the creation of a new genus. Gilg did not share my reluctance, and described a new genus, *Phæoneuron*, from Schweinfurth's plant mentioned above, and from several specimens which the Berlin Herbarium had received from the Cameroons, and which he considered identical with the former. The character adduced by the author to distinguish *Phæoneuron* from *Dicellandra* was in the structure of the andrœcium. This was, according to him, homœandrous (*i. e.* consisting of one kind of stamens) in *Phæoneuron*, and heterandrous (*i. e.* consisting of two conspicuously distinct sets) in *Dicellandra*. In his monograph of the African Melastomaceæ he admits three species for *Dicellandra*, viz.: *D. Barteri*, Hook. f.; *D. setosa*, Hook. f.; and *D. liberica*, Gilg, a new species collected by Dinklage in Liberia; and only one species for *Phæoneuron*, namely *Ph. dicellandroides*, Gilg.

At the time of my correspondence with Dr. Gilg, *Dicellandra* was represented at Kew only by the original specimens, and those mentioned before as referred to *D. Barteri* by Cogniaux. Since then a specimen of *D. liberica* and a number of specimens of *Phæoneuron* from the Cameroons have been added to the Kew Collections. When incorporating them, it struck me that the seeds of *D. liberica* agreed perfectly with those of *Phæoneuron*, but differed entirely from those which I found in a capsule attached to the sheet containing Barter's specimen of *D. Barteri*. As there was, however, no fruit left actually connected with the specimen, it was open to doubt whether those seeds really belonged to Barter's specimen. There was apparently then little chance of deciding this question. I wrote, however, to Gilg and asked him to tell me whether the seeds of *D. setosa* (of which specimens are in the Berlin herbarium) agreed with those of *D. Barteri* or of *D. liberica*, of both of which I sent him a drawing. Dr. Gilg was kind enough to communicate seeds of *D. setosa*, and a leaf, flower, and seeds of a plant collected by Dinklage near Gross Batanga, Cameroons (no. 851). The seeds of *D. setosa* agreed with those of Gilg's *D. liberica* and of his *Phæoneuron*; whilst Dinklage's specimen proved that the seeds in the capsule attached to Barter's specimen in the Kew Herbarium must actually have been taken from this specimen, on which the genus *Dicellandra* was partly established.

These two sets of seeds are very different. The seeds of *Dicellandra Barteri*, as represented by Barter's and Dinklage's (no. 851) specimens, are obovoid, with an attenuate base and a tongue- or horn-like appendage from the upper and posterior end (Pl. **19**. figs. 6, **7**, and fig. 1 in the text). This appendage is part of the raphe which occupies the posterior side down to the base. The raphe is, in the mature state, hollow with delicate walls, concave on the back, and more or less dark-coloured. The surface of the remainder of the seed is light brown, shining, and granular in the upper and anterior part. The

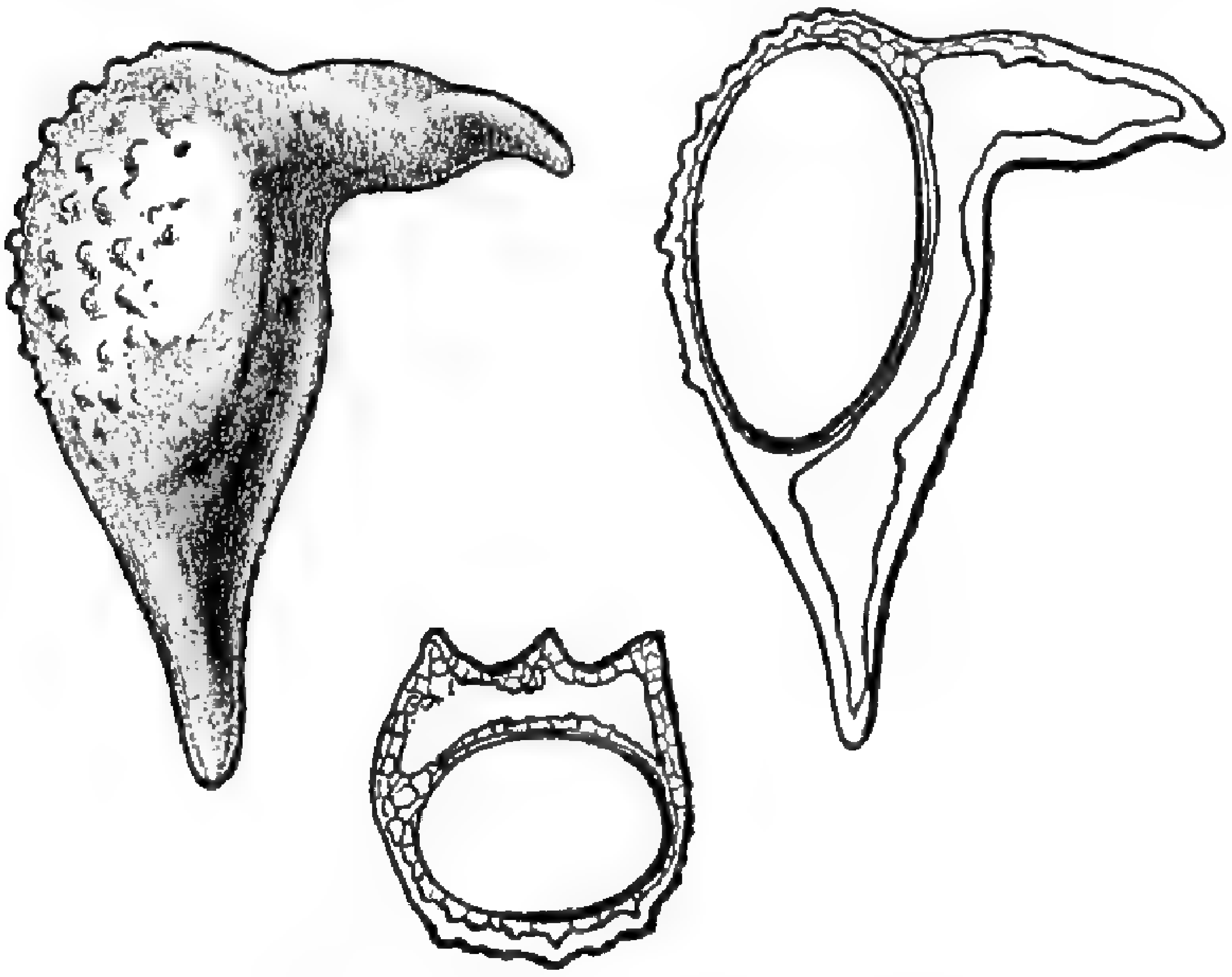

Fig. 1.—Seed of *Dicellandra Barteri.*

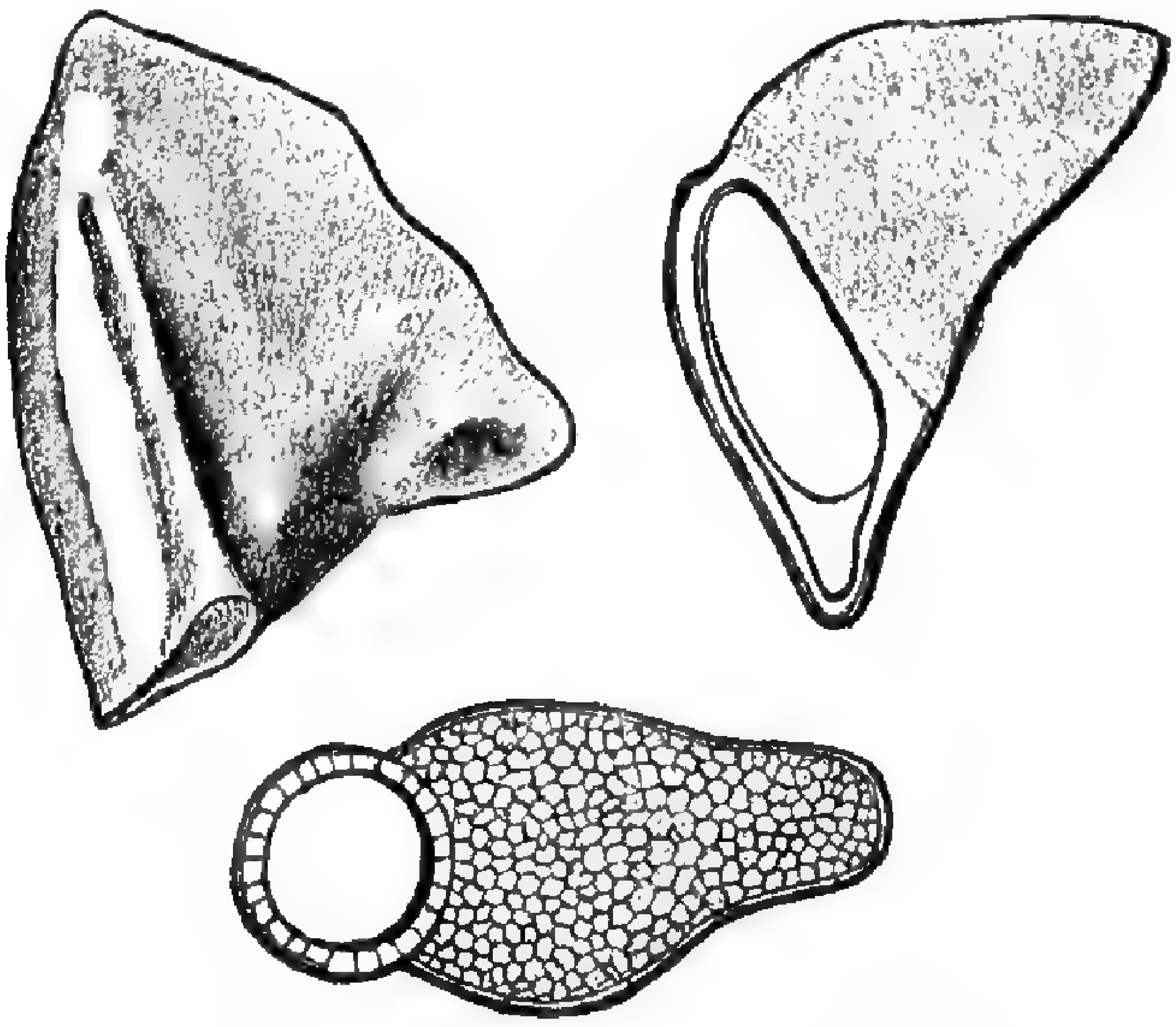

Fig. 2.—Seed of *Phæoneuron setosum.*

testa is thin and brittle, with the outer walls of the epidermal cells much thickened, and often produced into short papillæ (Pl. **19**. figs. 8, 10, and fig. 1 in the text), thereby causing the granular appearance mentioned above. The embryo is more or less ovoid, and occupies the part of the seed underlying the granular portion of the testa (Pl. **19**. figs. 7, 8, and fig. 1 in the text).

In *Phæoneuron*, on the other hand, the seeds are approximately of the shape of a short, thick wedge; the raphe is much larger and consists of a uniform spongy or corky tissue, whilst the surface of the seed is dull brown and smooth, and the embryo is more or less cylindric and occupies the anterior side of the seed down to or beyond the base of the raphe (Pl. **19**. figs. 14–16, and fig. 2 in the text).

These differences in the structure of the seeds are, in my opinion, much more fundamental than those adduced from the andrœcium, on which Gilg based the distinction of *Dicellandra* and *Phæoneuron*. It is true, our present system of Melastomaceæ rests to a very great extent on the structure of the andrœcium—more so than is the case in any other order of Phanerogamæ,—and particular stress has been laid on the homœandry or heterandry of the flowers. But, how do the stamens differ of the outer and inner whorl in *Dicellandra*, as defined by Gilg? They differ in the size of the anthers and of the small appendages at the base of the connective, and, what is considered more important, in the presence of a filiform prolongation of the connective between the anther and the basal appendages in the outer whorl of stamens. The difference, I may add, in the size of the anthers is considerable in *Dicellandra Barteri*, but slight in *D. liberica* (Pl. **19**. figs. 2, 3, and 12, 13). On the other hand, *Phæoneuron* is supposed to have all the stamens alike; but a closer examination reveals even here, at least in some of the species which I describe in the second part of the paper, a tendency towards heterandry, which manifests itself in a very slight prolongation of the base of the connective, so that the anticous appendages are somewhat removed from the anther in the outer whorl of stamens (Pl. **19**. figs. 17, 18). It is clear that the differences used so far to distinguish *Dicellandra* and *Phæoneuron* are purely dimensional: they show themselves at a relatively very advanced stage, and they do not point to greater differences in the general structure of the flower, such as would manifest themselves at an earlier period, and in more than one particularly specialized part. This is important, because differences which pervade a considerable portion or the whole of the reproductive apparatus, or even the entire organism, determine that association as characters in which we perceive the phyletic unity or, what is the same, the congenerity of two or more species. To return to the seeds, described above, it is clear that they differ not merely dimensionally, but structurally, and in a way which indicates at once that the differences must be correlated with further differences in the structure of the fruit generally, and probably also of those parts of the flower which go to form the fruit. The wedge shape of the seeds of *Phæoneuron* and *Dicellandra liberica* is due to their being closely packed with nothing between them. The seeds of *D. Barteri*, on the other hand, with their rounded surface would be impossible under similar conditions. They mature, indeed, in the soft, though probably somewhat dry, pulp of a berry, the pulp not only covering them but, as it seems, also filling up the interstices between them. As is usually the case in fruits of this class, the placenta takes part in the formation of the pulp, and the epicarp remains rather thin and delicate. The fruit of *Dicellandra Barteri* is evidently adapted to dissemination by animals, most likely by birds. Its occurrence as an epiphyte on old trees (according to notes by Barter and W. H. Johnson) becomes thus intelligible. *Phæoneuron* and *Dicellandra liberica* behave differently in this respect. The corky, closely packed seeds completely fill up the cells of the fruit. This has the shape of a berry, but the thin pericarp is dry and ultimately bursts as in other Melastomaceæ, under the pressure of the seeds. It dehisces along the median lines of the carpels from the top to the bottom, thus breaking up into five valves which are ultimately dropped. The seeds remain for some time attached to the placentas, which are transformed into thick bundles of fibres and remain behind long after the last seeds have fallen. I would suggest that the structure of the fruits and seeds of *Phæoneuron* and *Dicellandra liberica* are adapted to dissemination by water, corky appendages to the seeds being a common contrivance with plants which depend on water as the dispersing agency, and so far all the specimens which I have seen have actually been collected either on the banks of streams or in swamps.

The differences between *Dicellandra Barteri* on one side, and *D. liberica* and *Phæoneuron* on the other are, however, not confined to the seeds and fruits, but extend to the early stages of the flowers, although they are not conspicuous in their outward appearance, and have therefore been overlooked. How far they, or some of them, are determined by the ultimate development of the fruit, so different in both groups, it is impossible to say in our present imperfect knowledge of the case and with the little material at our disposal; but it is characteristic that they affect just those parts which go to build up the fruit, whilst the petals and the stamens which play a more transient, though not less important, rôle in the reproductive phase of the life of these plants, are, group compared with group, either alike (the petals) or exhibit differences (the androecium) which traverse the parallelism so evident in the development of the fruits of the *Phæoneuron* type. The differences in the flowers, which coincide so remarkably with those in the fruits, concern the ovary and the calyx which takes part in the formation of the fruit. The ground-plan of the ovary is the same in both groups, and agrees with that usually found in the 5-merous Melastomaceæ; and the ovary itself is, in both, completely surrounded and exceeded by the calyx-tube, which bears the petals and stamens on a circular rim situated somewhat above the top of the ovary. This is, in fact, a character common to all Melastomaceæ. But whilst the ovary of *Phæoneuron* is free with the exception of the lower third or fourth part, where it is completely connate with the calyx-tube (Pl. **19**. fig. 19), it is in *Dicellandra* joined with the calyx-tube by narrow radial lamellæ which run from the very top towards the base, in such a way that they divide the space between the ovary and the calyx-tube into ten pockets for the reception of the anthers in the bud (Pl. **19**. fig. 1). The pockets are alternately shorter and longer. Those which contain the longer anthers of the outer staminal whorl reach nearly to the base, the others about to the middle. I need not remind the reader that this is a very common arrangement in Melastomaceæ. In *Phæoneuron* there are no such lamellæ and no pockets. The ovary is quite free for about $\frac{2}{3}$ or $\frac{3}{4}$ of its length. Another difference concerns the top of the ovary. This bears in *Dicellandra* a crenulated, somewhat fleshy ring which surrounds the base of the style and is fringed with minute gland-tipped hairs (Pl. **19**. fig. 4). No trace of a similar appendage is noticeable in *Phæoneuron*. It is probable that these differences are in correlation with the differences in the mode of insect fertilization. As to the calyx itself, the

*Dicellandra* and *Phæoneuron* type differ in two respects. The calyx of *Dicellandra* is more or less funnel-shaped or obconic in bud, and subcampanulate when the petals open with a shortly and broadly 5-toothed limb (Pl. **19**. fig. 1); that of *Phæoneuron* is hemispheric in the young and the adult state, or slightly lengthened in the latter, and strictly truncate (Pl. **19**. fig. 11). The tube is rather thin in *Dicellandra*, but thick and succulent in *Phæoneuron*; and I have little doubt that an examination of the tissues composing the tube in both types would reveal differences quite in accord with the modification it undergoes in ripening.

I might have satisfied myself with condensing all these observations in a concise technical description as follows below; but I thought it worth while to show in a special case how fertile the rational perception of plant-structures is for the systematist, compared with the artificial method which rests satisfied with the superficial and (usually one-sided) comparison of external characters, particularly if they have gained, through some technically well-executed system, the reputation of being important as well as convenient. The external characters on which we base our systems are derived from the comparison of parts of the plants which have not only definite shapes and dimensions, but also definite functions to which they are more or less clearly adapted, and they have both not only *per se*, but as members of a living organism. As such, they are dominated by that fundamental law of the organic world which Wiesner has significantly called the principle of internal order and harmony ("Prinzip der inneren Ordnung und Harmonie"). They have assumed their shapes and adapted themselves to their functions whatever may have been the modelling influence of the environment, under constant interaction, in the short cycle of the life of the individual as well as in the long and slow process of the evolution of the phylum. This is the cause of the wonderful harmony in the œcology of the organisms, but also one of the sources of the extreme complexity of the relations in which the members of a phylogenetic unit stand to each other. But it is also the reason why all attempts to discover so-called absolute characters for the classification of the organic world are, *à priori*, doomed to failure. We cannot build up a logical system, starting from a preconceived *principium divisionis*, nor shall we ever find one in nature. Absolute characters have as much reality as the philosopher's stone. All we can do is patiently to seek the red line of affinity, not by singling out an imaginary more or less absolute character, but by viewing our objects from as many sides as possible, not as the corpses with which we have to deal in our museums but as living organisms. This may be a slow way, but it is the only one which promises lasting results. We cannot always wait for it for practical reasons, and artificial systems will have to be set up for the time to bring some sort of order into the chaos; but as our science advances, the excuses grow fewer and fewer, and the gain in stability outweighs more and more the outlay in time and labour.

To return from this excursion into the philosophy of systematic botany—and the same applies, of course, to systematic zoology—to our two Melastomaceous genera: the red line of affinity lies evidently not through that comparatively isolated differentiation of the connective which determines the homœandry or heterandry of the andrœcium, but through the much more complicated and closely correlated modifications of those parts of the flower which ultimately form the fruits and seeds. Their character is the same in *Phæoneuron* and in *Dicellandra liberica*, and we shall therefore have to refer the latter to *Phæoneuron*.

As to *Dicellandra setosa*, I have seen only fruits. These agree in every point completely with those of *D. liberica*; and as Sir Joseph Hooker's description very well fits the Liberian species, there is scarcely any doubt that both are identical. Both may therefore be united as *Phæoneuron setosum*. Gilg's original *Phæoneuron dicellandroides*, on the other hand, appears to me to comprise two distinct species, and a further species may be added, known from specimens collected by Moloney in Lagos. From seeds of this, a plant has been raised at Kew from which Sir Joseph Hooker has prepared a plate for the 'Botanical Magazine,' the species being named *Ph. Moloneyi* *. Thus the genus *Dicellandra* appears, in the present state of our knowledge, monotypic, whilst *Phæoneuron*, on the other hand, comprises four species. I give the technical description of the two genera and their species in the second part of my paper, and place those of the genera side by side in order to facilitate comparison.

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* It has since been published with tab. 7729.

## II.

| DICELLANDRA, *Hook. f.* (*in Benth. & Hook. Gen. Plant.* i. 757). (Pl. **19.** figs. 1–10.) | PHÆONEURON, *Gilg* (*in Engler & Prantl, Natürl. Pflanzenfam.*, Nachtr. 267). (Pl. **19.** figs. 11–20.) |
|---|---|
| *Flores* 5-meri. | *Flores* 5-meri. |
| *Calycis* furfuraceo-pubescentis tubus infundibulari-campanulatus, ultra ovarium productus; limbus 5-dentatus, dentibus brevibus, perlatis. | *Calycis* minutissime furfuraceo-pubescentis vel subglabri tubus hemisphæricus vel sub-hemisphæricus, ultra ovarium productus; limbus truncatus. |
| *Petala* elliptico-oblonga, acuminata. | *Petala* elliptica, apiculata. |
| *Stamina* 10, inæqualia, omnia fertilia; episepalorum antheræ majores anguste lanceolato-lineares, acuminatæ, connectivo basi producto, appendicibus anticis filiformibus acutis, postico breviter acute calcarato; epipetalorum staminum antheræ lanceolatæ, duplo minores, connectivo basi haud producto, appendicibus anticis brevibus acutis antheræ basi appressis, postico brevissime acuteque calcarato. | *Stamina* 10, inæqualia vel æqualia, omnia fertilia; episepalorum antheræ interdum paulo majores, lineari-lanceolatæ vel lineares, acutæ vel obtusæ, connectivo basi magis minusve producto vel haud producto, appendicibus anticis brevibus incrassatis obtusis, postico breviter calcarato; epipetalorum staminum antheræ similes, connectivo basi haud producto, appendicibus anticis antheræ basi appressis. |
| *Ovarium* ope septorum a vertice basin versus attenuatorum calyci adnatum, locellis inter septa alternatim ad medium vel ad basin decurrentibus, 5-loculare, vertice annulo crenulato glanduloso-ciliolato coronato; stylus filiformis, stigmate punctiformi. | *Ovarium* basi ad ¼ vel ⅓ tubo calycino adnatum, cæterum liberum, vertice nudo convexo, 5-loculare; stylus filiformis, stigmate punctiformi. |
| *Fructus* baccatus, globosus, pericarpio tenui; placentæ haud induratæ nec persistentes. | *Fructus* globosus, demum 5-sulcatus, loculicide a vertice ad basin dehiscens, pericarpio crassiusculo, epi- et mesocarpio spongiosis friabilibus et demum corrutis endocarpio tenuiter crustaceo diu persistente demum cum septis valvatim delabente; placentæ induratæ, fibrosæ, persistentes. |
| *Semina* in pulpa nidulantia, numerosa, obovoidea, superne postice appendiculata; testa tenuis, | *Semina* numerosa, fructus loculos arcte replentia, crassa, cuneiformia; testa subtenuis, crustacea, opaca, |

| | |
|---|---|
| crustacea, nitidula, superne granulata; raphe in seminis appendicem producta, cava, parietibus tenuibus; hilum basilare. | lævis; raphe ampla, solida, spongiosa; hilum subbasilare. |
| *Embryo* obovoideus vel ellipsoideus, semine multo brevior, eius basin haud attingens. | *Embryo* fere cylindricus, semini magis minusve æquilongus. |
| *Herba* terrestris vel epiphytica, caulibus acute tetragonis, foliis ovatis, 5–7-nervibus, inflorescentiis brevibus terminalibus et ex axillis superioribus ortis cymosis, paucifloris, floribus purpureis. | Suffrutices vel frutices terrestres, caulibus teretibus, demum lignosis, ramulis novellis subtetragonis, foliis ovatis vel lanceolatis, 5–7-nervibus, inflorescentiis corymboso-paniculatis, breviter pedunculatis, floribus roseis. |
| *Distributio*: Africa occidentalis, Nigeria, Fernando Po, Cameroons. | *Distributio*: Africa occidentalis, a Sierra Leone ad Monbuttuland. |

### 1. DICELLANDRA, *Hook. f.*

Species unica: D. BARTERI, *Hook. f.*, *l. c.* (Pl. **19.** figs. 1–10.)—Herba ad 4 ped. alta, in partibus novellis rufo-furfuraceo-pubescens, deinde glabrescens. Caulis crassus, inferne radicans. Folia ovata acuta vel sæpius breviter acuminata, basi acuta vel inferiora rotundata magnitudine valde inæqualia, majora ad 20 cm. longa et 11 cm. lata, margine magis minusve (interdum obscure) repando-denticulata, membranacea, supra mox glaberrima, infra ad nervos venasque diu vel persistenter furfuracea, nervis 7 a basi divergentibus vel intimis 3 breviter unitis, extimis submarginalibus, venis transversis horizontalibus 6–10 mm. remotis, reticulatione laxa; petioli circiter 10 cm. longi. Inflorescentiæ vix pollicares, dense rufo-furfuraceæ; bracteæ minutæ. Calyx 6 mm. longus. Petala calyci circiter æquilonga, purpurea. Fructus 1 cm. dimetiens. Semina 0·5–0·7 mm. longa.—*Triana in Trans. Linn. Soc.* xxviii. (1871) 81, t. 7. f. 85 *b*; *Cogniaux, Melastom. in DC. Suites au Prod.* vii. 546; *Gilg in Engl. & Prantl, Natürl. Pflanzenf., Nachträge*, 267, *& in Engl. Monogr. Afrik. Pflanzenfam.* ii. 33.

Gold Coast: Tumfa Hills near Akim, on dead logs and in humus collected on branches (*W. H. Johnson*, 50 *b*!). Nigeria: by the Nun River, epiphytic on old trees (*Barter*, 20113!). Cameroons: Gross-Batanga, on moist shady ground in forests (*Dinklage*, 851!).

To this species are to be referred with some reserve a specimen collected by G. Mann in the island of Fernando Po (no. 3), and one, collected by Dinklage, on the ground of moist shady forests near Gross-Batanga, Cameroons (no. 851). Both agree perfectly with Barter's specimens with the exception of the leaves, which are rather broader and have more numerous, closer, and more projecting transverse veins. One of the leaves of Mann's specimens measures 22 by 17 cm. and is cordate at the base. It is possible that these two specimens represent a distinct species.

### 2. PHÆONEURON, *Gilg.*

Andrœcium distincte heterandrum; connectivum staminum episepalorum basi inter antheram et appendices anticos longiuscule productum .... 1. *setosum.*

Andrœcium homœandrum vel subhomœandrum; connectivum staminum haud vel episepalorum brevissime productum.

  Petala 10–14 mm. longa; antheræ lineari-lanceolatæ, acutæ, 4–4·5 mm. longæ.

    Connectivum staminum episepalorum basi brevissime productum, calcare truncato...... 2. *dicellandroides.*

    Connectivum omnium staminum basi haud productum, appendicibus anticis antheræ appressis, calcare lato, minute 3-lobato .. 3. *Moloneyi.*

  Petala vix 6 mm. longa; antheræ 3 mm. longæ, episepalæ lineares obtusæ ................ 4. *Schweinfurthii.*

1. PH. SETOSUM, *Stapf**. (Pl. **19.** figs. 11–16.)—Frutex parce furfuraceo-pubescens, mox glabratus. Rami vetusti ad 8 mm. dimetientes, teretes, cortice griseo-brunneo, longitudinaliter fisso, ramis novellis superne obtuse quadrangularibus, setulis glanduligeris parce conspersis. Folia lanceolata vel oblongo-lanceolata, breviter acuminata, basi rotundata vel acuta, 7–9 cm. longa, 2·5–3 cm. lata, margine magis minusve (interdum obscure) repando-denticulata, denticulis sæpe in setulam abeuntibus, membranacea, glabra, nervis 5 a basi liberis, exterioribus margine admodum approximatis, nervis transversis creberrimis horizontalibus $1\frac{1}{2}$–$4\frac{1}{2}$ mm. remotis; petioli 8–15 mm. longi, graciles. Paniculæ 2–3 cm. longæ, basi 2·5–3 cm. latæ; bracteæ lanceolatæ, acutæ; pedicelli 2–3 mm. longi. Calyx oblongo-hemisphæricus, 6–8 mm.

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* In Bot. Mag. sub t. 7729.

longus, minutissime puberulus. Petala rosea, oblique elliptico-oblonga, minute apiculata, ad 17 mm. longa, 6 mm. lata. Antheræ episepalæ 9·5 mm. longæ, appendicibus anticis oblique truncatis, connectivi parte producta 2 mm. longa, epipetalæ vix 8 mm. longæ, connectivi parte producta brevissima, calcare admodum obscuro. Fructus 7–8 mm. dimetiens. Semina 1 mm. paulo longiore, angulo postico plerumque paulo producto.—Dicellandra ? setosa, *Hook. f. in Oliv. Fl. Trop. Afr.* ii. 459 ; *Cogniaux, l. c.* 546 ; *Gilg in Engl. Monogr. Afr. Pflanzenfam.* ii. 33 ; D. liberica, *Gilg, l. c.*

Sierra Leona (*Afzelius* !) ; Liberia, in ditches and swamps of the savannahs and forests, often gregarious (*Dinklage*, 2056 !).

2. PH. DICELLANDROIDES, *Gilg in Engl. & Prantl, Natürl. Pflanzenf., Nachtr.* 267. (Pl. **19.** figs. 17–20.)—Suffrutex, ad 2 m. altus. Rami vetusti, teretes, nigrescentes, ramulis novellis rufo-furfuraceis, mox glabratis. Folia ovata vel oblonga, interdum obliqua, acuta, basi rotundata vel subacuta, rarius subcordata, 8–20 cm. longa, 3·5–10 cm. lata, margine plerumque minute repando-denticulata, a basi 7-nervia, nervis exterioribus margini admodum approximatis, venis transversis horizontalibus ut nervis subtus minute furfuraceis, reticulatione inter venas tranversas vix ulla ; petioli foliorum cuiusque paris interdum inæquilongi, longiores ad 8 cm. longi, subgraciles. Paniculæ ad 2·5 cm. longæ, ad 4 cm. latæ ; bracteæ lanceolatæ, minutæ ; pedicelli (supra bracteas summas) 1–2 mm. longi. Calyx hemisphæricus, minutissime pubescens, 4–5 mm. longus. Petala violacea vel rosea, oblique elliptica, obscure apiculata, 10–12 mm. longa, 7–8 mm. lata. Antheræ episepalæ 5·5 mm. longæ, connectivo basi brevissime producto, appendicibus anticis tuberculiformibus, calcare truncato, epipetalæ vix minores. Fructus 7–8 mm. dimetiens. Semina 1 mm. paulo breviora.—*Gilg in Engl. Monogr. Afrik. Pflanzenfam.* ii. 35, t. viii. B (the Cameroon plant).

West Africa : Cameroons, Yaúnde, common in swamps, on the banks of streams, and in clearings of the woods (*Zenker & Staudt*, 159 ! *Zenker*, 1418 !) ; Bipinde, on the shady banks of streams (*Zenker*, 904 !) ; Gross-Batanga, on the banks of streams and the swampy ground of forests (*Dinklage*, 635 !) ; Kribi, by streams (*Preuss*, 261).

An imperfect specimen collected by G. Mann in the Sierra Crystal, Gaboon (no. 1680), may also belong to this species. It was quoted by Triana in Trans. Linn. Soc. xxviii. 81, under *Dicellandra Barteri*, Hook. f.

3. PH. MOLONEYI, *Stapf in Bot. Mag. ined.**—Suffrutex. Rami vetusti teretes, rubro-fuscescentes, ramis novellis dense purpureo- vel rufo-furfuraceis. Folia ovata vel ovato-oblonga, acuta vel subacuminata, basi rotundata vel subcordata, 9–15 cm. longa, 4–9 cm. lata, margine repando-denticulata, membranacea, supra deinde glabrata, infra in nervis venisque persistenter minute furfuracea, a basi 7-nervia, nervis exterioribus margini admodum approximatis, venis transversis horizontalibus, 3–6 mm. remotis, inter eas reticulatione vix ulla; petioli graciles 2·5–6 mm. longi. Paniculæ rufo-furfuraceæ, 3–5 cm. longæ, 5–8 cm. basi latæ; bracteæ lineares minutæ; pedicelli (supra bracteas summas) 1–2 mm. longi. Calyx hemisphæricus, vix 4 mm. longus, minutissime pubescens. Petala oblique obovata, subapiculata, 12 mm. longa, ad 7 mm. lata, rosea. Antheræ æquales, 4·5 mm. longæ, appendicibus antheræ basi appressis, calcare lato, minute trilobato. Fructus 6–7 mm. dimetiens. Semina vix 1 mm. longa.

Lagos (*Moloney*, 28!). Cult. in the Kew Gardens in 1884.

4. PH. SCHWEINFURTHII, *Stapf*†.—Suffrutex. Caulis inferne lignosus, teres, ramis novellis fusco- vel rufo-furfuraceis, mox glabratis. Folia elliptica vel ovato-elliptica, breviter acuminata, basi minute cordata, 7–13 cm. longa, 4–6 cm. lata, margine minute denticulata, a basi 7-nervia, venis transversis 2–4 mm. remotis horizontalibus minute furfuraceis, reticulatione inter eas vix ulla; petioli 1–2 cm. longi. Paniculæ multifloræ ad 4 cm. longæ, ad 7 cm. latæ, parce minutissime furfuraceæ; bracteæ lanceolato-ovatæ, minutæ; pedicelli brevissimi (supra bracteas summas). Calyx hemisphæricus, 3–3·5 mm. longus, minutissime pubescens. Petala rosea, elliptica acuta, 6 mm. longa. Antheræ æquilongæ, 3½ mm. longæ, episepalæ lineares, obtusæ, connectivo basi brevissime sed distincte producto, appendicibus tuberculiformibus, calcare lato, 3-lobato; antheræ epipetalæ, sublanceolatæ, subacutæ, connectivo basi haud producto, appendicibus calcareque minutis. Fructus 6 mm. dimetiens. Semina vix 1 mm. longa.

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* Since published, t. 7729.

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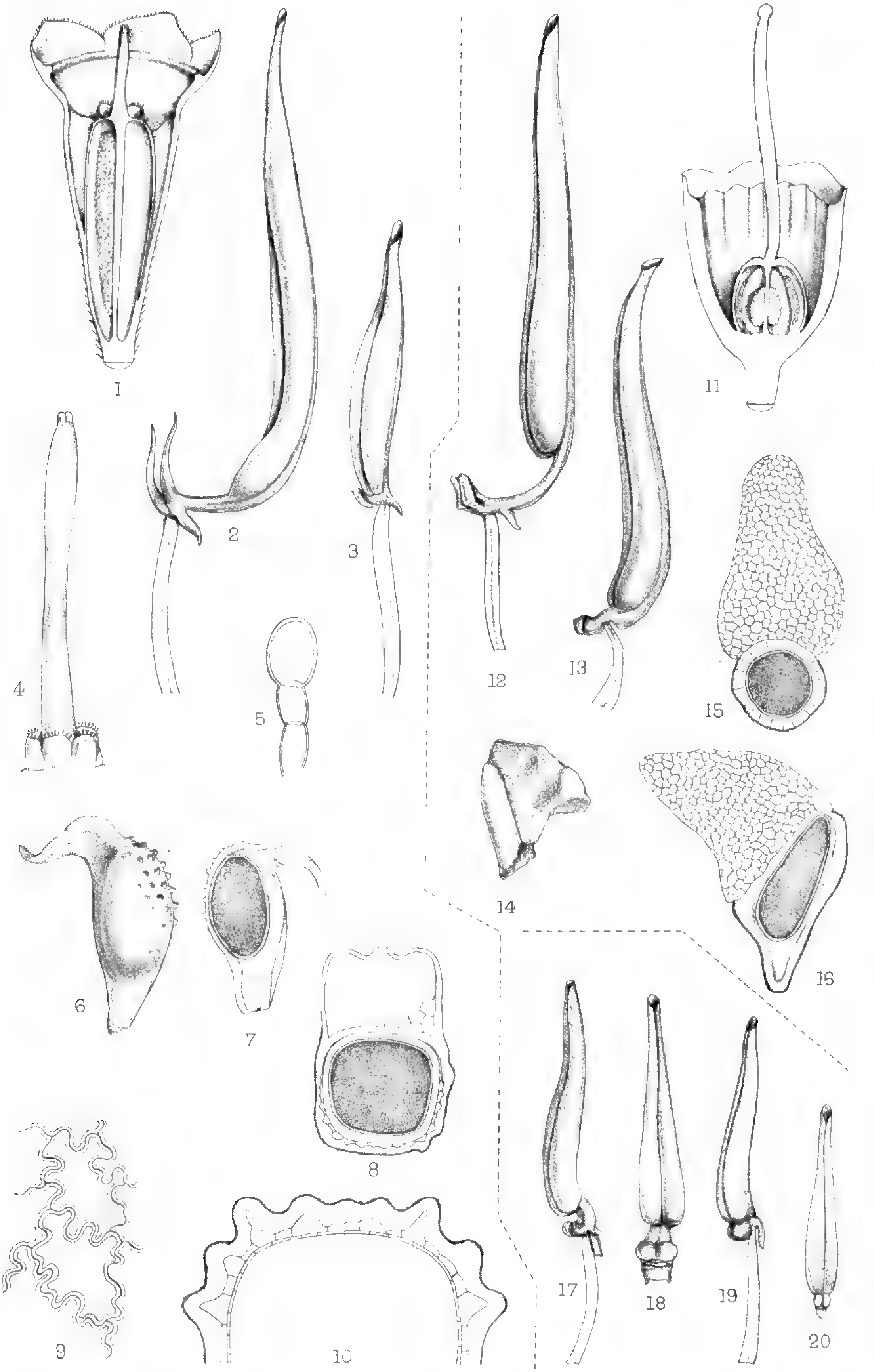
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O. Stapf del.
R. Morgan lith.

West, Newman imp

1-10: DICELLANDRA, Hook. f., 11-20: PHÆONEURON, Gilg.

Upper Nile basin: Monbuttuland, by the Kussumbo River (*Schweinfurth*, 3166 !).

## EXPLANATION OF PLATE 19.

Figs. 1–10. *Dicellandra Barteri*, Hook. f.

Fig. 1. Longitudinal section through a bud (with the petals and stamens removed), showing a long and a short pocket corresponding to the long and the short anther which they contained.
2. An episepalous stamen.
3. An epipetalous stamen.
4. Top of ovary and style.
5. A gland-hair from the annular appendage of the top of the ovary.
6. A seed.
7. The same, in longitudinal section.
8. The same, in cross section. The shaded portion represents here (as in fig. 7) the embryo. In the cavity behind it some remains of the tissue can be seen, the breaking up of which renders the raphe ultimately hollow.
9. Epidermis of the testa.
10. Section through the testa, showing the two cell-layers of which it consists.

Figs. 11–16. *Phæoneuron setosum*, Stapf.
(*Dicellandra setosa*, Hook. f.; *D. liberica*, Gilg.)

Fig. 11. Longitudinal section through a flower (with the petals and stamens removed). [Note. The ovary should be shown as connate with the calyx-tube, as described in the text.]
12. An episepalous stamen.
13. An epipetalous stamen.
14. A seed.
15. The same, in cross section.
16. The same, in longitudinal section.

Figs. 17–20. *Phæoneuron dicellandroides*, Gilg.

Fig. 17. An episepalous stamen (side view).
18. The same, in front view, with the filament removed.
19. An epipetalous stamen (side view).
20. Another epipetalous stamen, in front view, with the filament removed.

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